SCIENCE

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*ON MODIFICATION AND VARIATION.**

UP to a date still comparatively recent, the transmission to offspring, in greater or less degree, of those modifications of habit or structure which the parents had acquired in the course of their individual lifetime, was generally accepted. Lamarck is regarded as the intellectual father of the transmissionists. In his 'Histoire Naturelle' he said: "The development of organs and their power of action are continually determined by the use of these organs." This is known as his third law. In the fourth he insisted on the hereditary nature of the effects of such use. "All that has been acquired, begun or changed," he said, "in the course of their life is preserved in reproduction and transmitted to the new individuals which spring from those which have experienced the changes."

Darwin accepted such transmission as subordinate to natural selection, and attempted to account for it by his theory of pangenesis. According to that hypothesis all the component cells of an organism throw off minute gemmules, and these and their like, collecting in the reproductive cells, are the parental germs from which all the cells of the offspring of that organism are developed. This theory, here given in briefest outline, came in for its full share of

* Being a chapter from a forthcoming work on *Habit and Instinct* communicated at the request of Prof. Henry F. Osborn.

criticism. The problems of heredity were recognized as being of supreme biological importance and were warmly discussed. Meanwhile a different view of the relation between the organism and its reproductive cells came into prominence. With it the names of Francis Galton, in England, and August Weismann, in Germany, are inseparably connected. Of late years it has gained the approval of many, though by no means all, of our foremost biologists. This view, again given in briefest possible outline, is as follows: The fertilized egg of any many-celled organism gives origin to all the cells of which that organism is composed. In some of these, the reproductive cells, germinal substance is set aside for the future continuance of the race; the rest give rise to all the other cells of the body, those which constitute or give rise to muscle, nerve, bone, gland and so forth. Thus we have a division into germ-substance and body-substance. Germ gives origin to germ plus body; but the body takes no share, according to Prof. Weismann, in giving origin to—though it ministers to, protects, and may exercise an influence on—the germinal substance of the reproductive cells.

The logical development of this theory led Prof. Weismann to doubt the inheritance of characters acquired by the bodily substance in the course of individual life, and to examine anew the supposed evidence in its favor. For if brain substance, for example, contributes nothing to the reproductive cells, any modification it acquires during individual life can only reach the germ through some indirect mode of influence. But does it—does any modification of the body substance—so affect the germ as to become hereditary? Prof. Weismann answers this question by asserting that the evidence for the direct transmission of acquired characters is wholly insufficient, and by contending that, until satisfactory evidence is forthcoming, we may not accept transmission as a factor in evolution.

How, then, is progress possible if none of the modifications which the body suffers is transmitted from parent to offspring? To this question we must reply that though modification is, on this view, excluded from taking any direct share in race-progress, yet there is still variation. By modifications I mean those changes which are in some way wrought in the body-structure, and by variations those differences which are of germinal origin. That variation of germinal origin is a fact in organic nature is admitted on all hands, and that some variations are adaptive is also unquestioned. Transmissionists contend that modification in a particular direction in one generation is, through the transmission of the change in some way from the bodily tissues to the germinal cells, a source of variation in the same direction in the next generation. Selectionists, on the other hand, exclude this source of variation, contending that the supposed evidence in its favor is insufficient or unsatisfactory. But their whole theory depends on the occurrence of variations, of which those that are in unfavorable directions are weeded out, while those that are useful and adaptive remain in possession of the field. How these variations originate in the germ we need not here discuss. Let us assume that variations of germinal origin in a great number of directions do as a matter of fact occur.

This, then, is how the matter stands. All acknowledge the existence of variations and admit that their proximate source is in the fertilized ovum. All admit that the individual is, through its plasticity, in greater or less degree capable of adaptive modification. Transmissionists contend that the effects of modification are somehow transferred to the germinal substance there to give origin to variations. Selectionists deny this transmission and contend that adap-

tive variations are independent of adaptive modifications.

Now, what is natural selection, at any rate as understood by the master—Darwin? It is a process whereby, in the struggle for existence, individuals possessed of favorable and adaptive variations survive and hand on their good seed, while individuals possessed of unfavorable variations succumb, are sooner or later eliminated, standing therefore a less chance of begetting offspring. This is the natural selection of Darwin. But it is clear that to make the difference between survival and elimination the favorableness of the variation must reach a certain amount—varying with the keenness of the struggle. This was termed by Romanes 'selection value.' And one of the difficulties which critics of natural selection have felt is that the little more or the little less of variation must often be too small in amount to be of selection value so as to determine survival. This difficulty is admitted by Prof. Weismann as a real one. "The Lamarckians were right," he says, "when they maintained that the factor for which hitherto the name of natural selection had been exclusively reserved, viz., personal selection [*i. e.*, the selection of individuals], was insufficient for the explanation of the phenomena."* And again:† "Something is still wanting to the selection of Darwin and Wallace, which it is obligatory on us to discover, if we possibly can."

The additional factor which Dr. Weismann suggests is what he terms germinal selection. This, briefly stated, is as follows: There is a competition for nutriment among those parts of the germ from which the several organs or groups of organs are developed. These he names determinants; in this competition the stronger determinants get the best of it, and are further developed at the expense of the weaker determinants, which are starved and tend to dwindle and eventually disappear. The suggestion is an interesting one, but one well-nigh impossible to put to the test of observation. It must at present be placed among the 'may-bes' of biology. If accepted as a factor, it would serve to account for the existence of determinate variations, that is to say, variations along special or particular lines of adaption.

Such determinate variations are, however, explicable on the theory of natural selection—a term which, in my opinion, should be reserved for that process of individual survival and elimination to which it was applied by Darwin. Writing in 1892 I put the matter thus:* "Take the case of an organism which has in some way reached harmony with its environment. Slight variations occur in many directions, but these are bred out by intercrossing. It is as if a hundred pendulums were swinging just a little in many directions, but were at once damped down. Now, place such an organism in changed conditions. The swing of one or two of the pendulums is found advantageous; the organisms in which these two pendulums are swinging are selected; they mate together and in their offspring, while these two pendulums are by congenital inheritance kept a-swinging, the other 98 pendulums are rapidly damped down as before.

"Let us suppose, then, that the variation in tooth structure, in a certain mechanically advantageous direction, be such a selected pendulum swing. That particular pendulum, swinging in that particular direction, will be the subject of selection. The other pendulums will still be damped down as before, and in that particular pendulum variations from the particular direction will be similarly damped down. It will wobble a little, but its wobbling will be as nothing compared with the swing that is

* *Germinal Selection*, Monist Jan., 1896, p. 290.
† *Op cit.* p. 264.

* *Natural Science*, Vol. I., April, 1892, pp. 100–101.

fostered by selection. In this case, then, selection will choose between the little more complexity that is advantageous and the little less complexity that is disadvantageous. The little less complexity will be eliminated, the little more complexity will survive. The little less and the little more are, however, in the same line of developmental swing. Hence, the variations discoverable in fossil mammals in which tooth development along special lines is in progress, will, on the hypothesis of selection, be plus and minus along a given line; in other words, the variations will be determinate, and in the direction of special adaptation."

Prof. Weismann adopts a similar position in his recent paper on germinal selection.* "By the selection alone," he says, "of the plus or minus variations of a character is the constant modification of that character in the plus or minus direction determined. * * * We may assert therefore, in general terms, that a definitely directed progressive variation of a given part is produced by continued selection in that definite direction. This is no hypothesis, but a direct inference from the facts and may also be expressed as follows: By selection of the kind referred to, the germ is progressively modified in a manner corresponding with the production of a definitely directed progressive variation of the part."

In his Romanes Lecture, Prof. Weismann makes another suggestion which is valuable and helpful and which, I think, may be further developed and extended. He is there dealing with what he terms 'intra-selection,' or that individual plasticity to which I have frequently made reference. One of the examples that he adduces is the structure of bone. "Herman Meyer," he says,† "seems to have been the first to call attention to the adaptiveness as regards minute structure in animal tissues, which is most strikingly exhibited in the structure of the spongy substance of the long bones in the higher vertebrates. This substance is arranged on a similar mechanical principle to that of arched structures in general; it is composed of numerous fine bony plates so arranged as to withstand the greatest amount of tension and pressure, and to give the utmost firmness with a minimum expenditure of material. But the direction, position and strength of these long bony plates are by no means congenital or determined in advance; they depend on circumstances. If the bone is broken and heals out of the straight, the plates of the spongy tissue become rearranged so as to be in the new direction of greatest tension and pressure; thus they can adapt themselves to changed circumstances."

Then, after referring to the explanation, by Wilhelm Roux, of the cause of these wonderfully fine adaptations by applying the principle of selection to the parts of the organism in which, it is assumed, there is a struggle for existence among each other, Prof. Weismann proceeds to show* that "it is not the particular adaptive structures themselves that are transmitted, but only the quality of the material from which intra-selection forms these structures anew in each individual life. * * * It is not the particular spongy plates which are transmitted, but a cell mass, that from the germ onwards so reacts to tension and pressure that the spongy structure necessarily results." In other words it is not the more or less definite congenital adaptation that is handed on through heredity, but an innate plasticity which renders possible adaptive modification in the individual.

This individual plasticity is undoubtedly of great advantage in race progress. The adapted individual will escape elimination

* *Monist*, Jan., 1896, p. 268.

† Romanes Lecture on *The Effect of External Influences on Development*, pp. 11, 12.

* Romanes Lecture, p. 15.

in the life-struggle, and it matters not whether the adaptation as reached through individual modification of the bodily tissues, or through racial variation of germinal origin. So long as the adaptation is there—no matter how it originated—that is sufficient to secure survival. Prof. Weismann applies this conception to one of those difficulties which have been urged by critics of natural selection. "Let us take," he says,* "the well-known instance of the gradual increase in development of the deers' antlers, in consequence of which the head, in the course of generations, has become more and more heavily loaded. The question has been asked as to how it is possible for the parts of the body which have to support and move this weight to vary simultaneously and harmoniously if there is no such thing as the transmission of the effects of use or disuse, and if the changes have resulted from processes of selection only. This is the question put by Herbert Spencer as to '*co-adaptation*,' and the answer is to be found in connection with the process of intra-selection. It is by no means necessary that all the parts concerned—skull, muscles and ligaments of the neck, cervical vertebræ, bones of the fore-limbs, etc—should simultaneously adapt themselves *by variation of the germ* to the increase of the size of the antlers, for in each separate individual the necessary adaptation will be temporarily accomplished by intra-selection," that is, by individual modification due to the innate plasticity of the parts concerned. "The improvement of the parts in question," Prof. Weismann urges, "when so acquired, will certainly not be transmitted, but yet the primary variation is not lost. Thus when an advantageous increase in the size of the antlers has taken place, it does not lead to the destruction of the animal in consequence of other parts being unable to suit themselves to it. All parts of the organism are in a certain degree variable [*i. e.*, modifiable] and capable of being determined by the strength and nature of the influences that affect them; and this capacity to respond conformably to functional stimulus must be regarded as the means which make possible the maintenance of a harmonious co-adaptation of parts in the course of the phyletic metamorphosis of a species. * * * As the primary variations in the phyletic metamorphosis occurred little by little, the secondary adaptations would as a rule be able to keep pace with them."

So far Prof. Weismann. According to his conception, variations of germinal origin occur from time to time. By its innate plasticity the several parts of an organism implicated by their association with the varying part are modified in individual life in such away that their modifications cooperate with the germinal variation in producing an adaption of double origin, partly congenital, partly acquired. The organism then waits, so to speak, for a further congenital variation, when a like process of adaptation again occurs; and thus race-progress is effected by a series of successive variational steps, assisted by a series of cooperating individual modifications.

If now it would be shown that, although on selectionist principles there is no transmission of modification due to individual plasticity, yet these modifications afford the conditions under which variations of like nature are afforded an opportunity of occuring and of making themselves felt in race-progress, a further step would be taken towards a reconciliation of opposing views. Such it appears to me, may well be the case.

To explain the connection which may exist between modifications of the bodily tissues due to innate plasticity (intra-selection) and variations of germinal origin in similar adaptive directions, we may re-

* Romanes Lecture, pp. 18, 19.

vert to the pendulum analogy which was adduced a few pages back. Assuming that variations do tend to occur in a great number of divergent directions we may liken each to a pendulum which tends to swing; nay, which is swinging through a small arc. The organism, so far as variation is concerned, is a complex aggregate of such pendulums. Suppose then that it has reached congenital harmony with its environment. The pendulums are all swinging through the small arc implied by the slight variations which occur even among the offspring of the same parents. No pendulum can materially increase its swing; for since the organism has reached congenital harmony with its environment, any marked variation will be out of harmony and the individual in which it occurs will be eliminated. Natural selection, then, will ensure the damping down of the swing of all the pendulums within comparatively narrow limits.

But now suppose that the conditions of the environment somewhat rapidly change. Congenital variations will not be equal to the occasion. The swing of the pendulums concerned cannot be rapidly augmented. Here individual plasticity steps in to save some of the members of the race from extinction. They adapt themselves to the changed conditions through a modification of the bodily tissues. If no members of the race have sufficient plasticity to effect this accommodation the race will become extinct, as has indeed occurred again and again in the course of geological history. The stereotyped races have succumbed; the plastic races have survived. Let us grant, then, that certain organisms accommodate themselves to the new conditions by plastic modification of the bodily tissues, say by the adaptive strengthening of some bony structure. What is the effect on congenital variations? Whereas all the other pendulums are still damped down by natural selection as before, the oscillation of the pendulum, which represents a variation in this bony structure, is no longer checked. It is free to swing as much as it can. Congenital variations in the direction of adaptive modification will be so much to the good of the individual concerned. They will constitute a congenital predisposition to that strengthening of the part which is essential for survival. Variations in the opposite direction, tending to thwart the adaptive modification, will be disadvantageous and will be eliminated. Thus, if the conditions remain constant for many generations, congenital variation will gradually render hereditary the same strengthening of bone structure that was provisionally attained by plastic modification. The effects are precisely the same as they would be if the modification in question were directly transmitted in a slight but cumulatively increasing degree. They are reached, however, in a manner which involves no such transmission.

To take a particular case: Let us grant that, in the evolution of the horse tribe, it was of advantage to this line of vertebrate life that the middle digit of each foot should be largely developed and the lateral digits reduced in size; and let us grant that this took its rise in adaptive modification through the increased use of the middle digit and the relative disuse of the lateral digits. Variations in these digits are no longer suppressed and eliminated. Any congenital predisposition to increased development of the middle digit and decreased size in the lateral digits will tend to assist the adaptive modification and to supplement its deficiencies. Any congenital predisposition in the contrary direction will tend to thwart the adaptive modification and to render it less efficient. The former will let adaptive modification start at a higher level, so to speak, and thus enable it to be carried a step further. The latter

will force it to start at a lower level, and will prevent its going so far. If natural selection take place at all, we may well believe that it would do so under such circumstances.* And it would work along the lines laid down for it in adaptive modification. Modification would lead; variation follow in its wake. It is not surprising that for long we believed that modification was transmitted as hereditary variation. Such an interpretation of the facts is the simpler and more obvious. But simple and obvious interpretations are not always correct. And if, on closer examination, in the light of fuller knowledge, they are found to present grave difficulties, a less simple and less obvious interpretation may claim our provisional acceptance.

In his recent paper on Germinal Selection Prof. Weismann says:† "I am fain to relinquish myself to the hope that now, after another explanation has been found, a reconciliation and unification of the hostile views is not so very distant, and that then we can continue our work together on the newly laid foundations." As one to whom Prof. Weismann alludes as having expressed the opinion that the Lamarckian principle must be admitted as a working hypothesis, I am now ready to relinquish myself also to the same hope. Germinal Selection does not convince me, though I regard it as a suggestive hypothesis; and assuredly I am not convinced by the argument that because in certain cases, such as the changes in the chitinous parts of the skeleton of insects and crustacea, and in the teeth of mammals, use and disuse can have played no part, therefore in no other cases has use-inheritance prevailed. Even Homer sometimes nods, and Prof. Weismann's logical acumen seems to have deserted him here. But it appears to me that on the lines I have sketched out, it is open to us to accept the facts adduced by the transmissionists and at the same time interpret them on selectionist principles.

It may be well now briefly to summarize the line of argument in a series of numbered paragraphs.

1. In addition to what is congenitally definite in structure or mode of response, an organism inherits a certain amount of innate modifiability or plasticity,

2. Natural selection secures:
   (*a*) such congenital definiteness as is advantageous.
   (*b*) such innate plasticity as is advantageous.

3. Both *a* and *b* are commonly present; but uniformity of conditions tends to emphasize the former variable conditions of life, the latter.

4. The organism is subject to:
   (*a*) variation of germinal origin.
   (*b*) modification of environmental origin, affecting the soma or body tissues.

5. Transmissionists contend that somatic modification in a given direction in one generation is transmitted to the reproductive cells to constitute a source of germinal variation in the same direction in the next generation.

6. It is here suggested that persistent modification through many generations, though not transmitted to the germ, nevertheless affords the opportunity for the occurrence of germinal variation of like nature.

7. Under constant conditions of life, though variations in many directions are occurring in the organisms which have reached harmonious adjustment to these conditions, yet natural selection eliminates all those which are of such amount as to be disadvantageous, and thus acts as a check on all variations, repressing them to within narrow limits.

* Prof. Weismann's 'Germinal Selection' if a *vera causa* would be a cooperating factor and assist in producing the requisite variations.

† *Monist, loc cit*, p. 290.

8. Let us suppose, however, that a group of organisms belonging to a plastic species is placed under new conditions of environment.

9. Those whose innate somatic plasticity is equal to the occasion survive. They are modified. Those whose innate plasticity is not equal to the occasion are eliminated.

10. Such modification takes place generation after generation, but, as such, is not inherited. There is no transmission of the effects of modification to the germinal substance.

11. But variations in the same direction as the somatic modification are now no longer repressed and are allowed full scope.

12. Any congenital variations antagonistic in direction to these modifications will tend to thwart them and to render the organism in which they occur liable to elimination.

13. Any congenital variations similar in direction to these modifications will tend to support them and to favor the individuals in which they occur.

14. Thus will arise a congenital predisposition to the modifications in question.

15. The longer this process continues, the more marked will be the predisposition and the greater the tendency of the congenital variations to conform in all respects to the persistent plastic modifications; while

16. The plasticity continuing the operation, the modifications become yet further adaptive.

17. Thus plastic modification leads and germinal variation follows; the one paves the way for the other.

18. Natural selection will tend to foster variability in given advantageous lines when once initiated, for (*a*) the constant elimination of variations leads to the survival of the relatively invariable; but (*b*) the perpetuation of variations in any given direction leads to the survival of the variable in that direction. Lamarckian palæontologists are apt to overlook this fact that natural selection produces determinate variation.

19. The transmissionist, fixing his attention first on the modification, and secondly the fact that organic effects similar to those produced by the modification gradually become congenitally stereotyped, assumes that the modification *as such* is inherited.

20. It is here suggested that the modification *as such* is not inherited, but is the condition under which congenital variations are favored and given time to get a hold on the organism, and are thus enabled by degrees to reach the fully adaptive level.

When we remember that plastic modification and germinal variation have been working together all along the line of organic evolution, to reach the common goal of adaptation, it is difficult to believe that they have been all along wholly independent of each other. If the direct dependence advocated by the transmissionists be rejected, perhaps the indirect dependence here suggested may be found worthy of consideration.

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NATURE STUDY AND INTELLECTUAL CULTURE. *

It is impossible to dissociate the intellectual effect of 'nature study' from the other factors in training which habitually accompany it. So far as I know, no 'pure culture' to determine the specific effect of nature study has ever been attempted; so that the best that can be done is in the way of reasonable inference. There can be no doubt that much of its effect is cumulative rather than specific, and so becomes merged and lost among other agencies. In addition to this general result, however, it is

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claimed that it has an effect of its own, not to be duplicated by any other subject. It is this specific effect of nature study that we are especially interested in discovering. The argument for nature study as a means of general training is based upon the claim that the subject-matter appeals more strongly to the interest of the young than almost any other that can be presented. The enormous momentum gained by interest is too well known to need discussion. That objects in nature, especially living objects, arouse the most lively interest in children, is the common testimony of all those who deal with children. It seems logical to take advantage of this interest in any intellectual training, and to press the subject matter to all its possible applications, thus reinforcing or even supplanting work technically belonging to other departments. The possible applications of nature study to numbers, to language, to drawing, are well known and extensively utilized. These propositions fail if interest in subject-matter is of no advantage in intellectual training, or if natural objects are not of large interest to children. My claim is that nature is not merely of large interest, but of supreme interest to children; that it supplies the most natural material by means of which the child may be developed intellectually in various directions; and that failure to use it is to neglect a broad highway and to attempt an advance through the thickets. I know that some will claim that power is developed by the resistance of the thickets; but it should be remembered that precisely the same power will be developed by covering a longer distance upon the highway, especially when the latter has the impetus of consent. The law of the conservation of energy has its application in things intellectual as well as in things physical. The greater the resistance, the less the distance, and *vice versa*. The method all depends upon whether we are seeking for resistance or distance; in both cases the resulting power will remain the same. I have never ceased to wonder at the systems of education which base their training, in effect, upon the proposition that the most natural impulses are to be repressed; that natural tastes are to be set aside for those artificially stimulated; that the great open book of objective nature is to be closed, and conventional subjective matter presented. From my own standpoint, this is intellectual distortion, as much as are the heads of Flathead Indians or the feet of Chinese women physical distortions. The subject is difficult to present in its true light, for we are still under the domination of a conventional education, which has worked out its results for centuries, and its good results are overwhelmingly in evidence because they are our only results. Now that the republican idea of larger rights for all subjects is persistently intruding itself, the old aristocracy needs most careful scrutiny. It has certainly done the best it could; but this is no reason why some other form of organization may not do better. The human mind develops in spite of subjects and teachers; but our purpose should be to remove all possible obstructions. It has been an annual experience of mine for many years to come in contact with the product of primary and secondary schools from which nature study has been rigidly excluded, and it must be confessed that the 'all round' training claimed has resulted in the narrowest conceivable intellectual product. The evils of early specialization are no where so apparent as in the schools which prepare for college. It is true that many colleges demand this specialization for entrance, continue it in their own courses, and then deny an adequate representation of nature study upon the ground that this means specialization. The tentacles of inquiry which the child naturally reaches out to nature become insensitive through dis-

use; and only here and there, in the later college experience, are some found still functional enough to be stimulated into activity. The public school system is seeking to better the product; but it is discouraging so long as colleges demand specialization rather than an 'all round' training.

It may be worth while to call attention to the fact that 'nature study' holds no relation to the study of the subject-matter as presented in text-books, and that such a presentation of it has no value in a scheme of education that does not belong to any other subject presented in the same way, and for purposes of training might as well be eliminated. The young mind does not reach out after the text-book, but after natural objects themselves. This distinction should be rigidly regarded, and text-book work should never be admitted into the category of 'nature study.' I grant to the old aristocracy all the strictures upon the results of science study it may care to impose if this study is to be one of text-books. One of the prominent things claimed for nature study is that it breaks the shackles of slavery to the book and introduces that intellectual freedom in which one sees and thinks for himself.

This position of nature study, however, as a means of general culture, as providing the most favorable subject-matter for arousing interest, is aside from the chief purpose of this paper, which is to discover its peculiar intellectual result, a result which cannot be obtained by the use of any other subject, and without which intellectual development is incomplete.

It is commonly stated that the prominent results of nature study are the cultivation of the power of observation and of drawing conclusions from observed facts. This is certainly a beneficent result, but it cannot be claimed as one peculiar to nature study; for it simply depends upon a method, the laboratory method, which may be applied to a wide range of subjects. It is certain that nature study has introduced the laboratory method into education, but having introduced the method it cannot lay claim, as a subject, to all the results. It is, perhaps, true that the laboratory method is most conveniently and completely applied in nature study; and that in most cases the definite training in observation and deduction is still obtained from nature study; but this will become less true as proper educational methods are developed. For this reason I take issue with a statement too frequently made by those who have had no training in science, that the function of science in an educational scheme is to teach laboratory methods. It is true that science, by its example, has been the great teacher of the laboratory method, but that is not its function any more than the device of algebraic symbols is the function of mathematics. A method is not a purpose, but has a purpose in view.

Another conception of the function of nature study is that it cultivates the power and habit of analysis, and that its purpose is analysis. This is a persistent conception of science in the popular mind, and also in the minds of many teachers of science, judging by their methods. This, however, is no more the purpose of nature study than is the laboratory method. The latter is its method, the former its preliminary step. This preliminary step, called analysis, is no more peculiar to nature study than are observation and deduction; although it may be more extensively and definitely cultivated in the so-called laboratories of science than in other laboratories. The ultimate purpose of nature study, and its peculiar function in a system of education is through analysis to reach synthesis. Its purpose is a constructive one, based upon facts which analysis reveals. It may seem strange to some to regard the purpose of science as a synthetic one, and the final

synthesis, which gives significance to analysis, certainly does not find any place in the practice of many teachers, but without it the real purpose is missed. It may be claimed justly that the reaching of synthesis through analysis is no more peculiar to nature study than are observation, deduction and analysis; but the mental attitude involved in reaching this synthesis *is* peculiar. This peculiar mental attitude may be most clearly stated, perhaps, in the form of a comparison. A very commonly used classification of studies in general is that which divides them into the 'humanities' and the 'sciences.' It lies outside of my present purpose to take exception to this exceedingly crude and misleading classification, but for the sake of comparison it will serve as well as any other. The 'humanities' are dominated by literature in the broadest sense, and are claimed to develop in the student a kind of culture especially desirable, a flavor especially characteristic of the educated man. To this claim I would not offer the slightest objection, for the 'humanities' have been and must continue to be a noble course of intellectual development, without which an education is certainly incomplete. I realize the difficulty to-day in sharply defining those studies which should be included under the 'humanities,' and a difficulty equally great in defining those to be included under 'sciences,' for it is often a thing of method rather than of subject-matter which determines the position of a study. However, there is no misunderstanding as to the general significance and effect of the group of studies known as the 'humanities.' It is the most ancient and best known form of culture, and being ancient and bound up with the development of mankind it must continue necessarily to hold high rank.

The general effect of the humanities in a scheme of education may be summed up in the single word *appreciation*. They seek so to relate the student to what has been said or done by mankind that his critical sense may be developed, and that he may recognize what is best in human thought and action. To recognize what is best involves a standard of comparison. In most cases this standard is derived and conventional; in the rare cases it is original and individual. In any case, the student injects himself into the subject; and the amount he gets out of it is measured by the amount of himself he puts into it. It is the artistic, the æsthetic, which predominates, not the absolute. It is all comparative rather than actual. The ability to 'read between the lines' is certainly the injection of self into subject-matter. It would seem fair, therefore to state the peculiar effect of the 'humanities' as being the power of appreciation or self-injection.

My claim is that any education which stops with this result is an incomplete one, and that there is another mental attitude which is a necessary complement before a full-rounded education can be claimed, and this complementary mental attitude is developed by a proper study of the so-called 'sciences.' It has been a matter of wonder to me that the student who confines himself to 'humanities' is so often spoken of as the 'all-round' student; while the one who studies the 'sciences,' and from whom the 'humanities' are as a matter of course demanded, is spoken of as the narrow student. In the very nature of things, in the very structure of our educational schemes, the student of science is compelled to be the broadest, most 'all-round' student we have. If the study of nature is conducted so as to cultivate merely a sentimental appreciation of natural objects, it does not fall within the category I am considering, and can in no way be considered a study which acts as a complement to the humanities. It is merely more of the same thing. Teachers of science are too apt to cultivate a factitious interest in

their subject-matter by this attempt at self-injection, and so destroy the peculiar advantage of the subject in intellectual training. If the proper intellectual result of the humanities is *appreciation*, whose processes demand *self-injection*, the proper and distinctive intellectual result of the sciences is *law*, to obtain which there must be rigid *self-elimination*. Any injection of self into a scientific synthesis vitiates the result. The standard is not a variable, an artificial one developed from the varying tastes of man, but absolute, founded upon eternal truth.

It is evident that this basis of distinction will result in a classification of subjects differing considerably from the ordinary grouping under 'humanities' and 'sciences,' but I am convinced that from the standpoint of mental development it is fundamental. It would even result in the divorcing of certain subjects now commonly included under one head. For example, it would certainly sharply cut off certain phases of language-study from literature proper, a fact which the universities have long recognized. This further emphasizes the fact that no hard and fast lines can be drawn separating the specific effects of the various studies. In our analysis we strip off the flesh and lay bare the skeleton, and are apt to lose sight of the fact that the contour is a composite result. Although the skeletons of the humanities and of the sciences may differ from each other in the fundamental way described, I cannot conceive of the resulting contour of the one as distinct from combination with the other. The self-elminating result of science must be associated with the self-injecting result of the humanities, even though science alone be studied; and the power of appreciation developed by the humanities must always be tempered by the scientific instinct. And yet the two processes and the two results are so distinct and so complementary that any system of education which does not provide for the definite cultivation of these two mental attidudes, and which leaves the complementary part merely to the chances of teaching methods and mental structure, is in constant danger of resulting in mental distortion.

John M. Coulter.
University of Chicago.

THE FATE OF A EUROPEAN BISON HERD.

In a paper entitled 'Das allmähliche Aussterben des Wisents (*Bison bonasus* Linn.) im Forste von Bjelowjesha'* Mr. Eugen Büchner gives a detailed history of the bison herd in the Bieloviejsha (or Bialowitza) forest, Province of Grodno, in Lithuania, Russia, during the present century. In his opening paragraph the author states that his purpose is two-fold: to make a critical historical study of this herd during the period for which the necessary data are available; and to find what light, if any, this history may throw on the general subject of the extinction of the larger mammalia.

Up to the year 1832 the accounts of the condition of the bison in the Bieloviejsha forest are conflicting and untrustworthy, but the number of animals in the herd during that period is estimated at from 300 to 800. Since 1832 a yearly census of the bison has been taken by the government of the forest. The count is made each winter immediately after the first snowfall, but must necessarily be only approximately accurate. The figures show an apparent slow increase from 770 head, the number recorded in 1832, to 1,898 head, the maximum reached in 1857. After 1857 there was a steady decrease until the minimum of 380 head was reached in 1889. During the three succeeding years there appears to have been a slight increase.

After presenting these figures the author at once attacks the question as to the cause

*Memoires de l'Academie impériale des sciences de St. Petersburg, Vol. III., No. 2, p. 1–30, 1895.

which can produce such marked and unfavorable results in a herd protected as carefully as that in the Bieloviejsha forest. The factors which have brought about this decrease may be divided into two principal categories: first, those wholly external; and second, those proceeding from the animals themselves. Under the first head are discussed: hunting, poaching, taking of live specimens for zoological gardens, ravages of beasts of prey and of various diseases, and finally possible deaths from shortage of food supply. As all these factors taken together are shown to be insufficient to account for the present condition of the herd, the true reason must be sought in the animals themselves. As long ago as 1830 Jarocki noticed that the bison cows as a rule calve only once in three years, and this observation has been repeatedly verified. The question at once arises whether this low grade of fertility is natural or otherwise. A careful study of the breeding habits of the bison in the Bieloviejsha forest and elsewhere leaves no room for doubt that the present slow rate of reproduction is an abnormal condition, and that to it is due the rapid approach of the extinction which is the certain fate of the herd under consideration. This diminished fertility the author regards as a stigma of degeneration caused by in-breeding. Associated with it are other stigmata, such as fatty degeneration of various organs and abnormal condition in parts of the skeleton. Many of the bison cows are known to be wholly unable to care for their calves through lack of milk. The process of degeneration has progressed so far that the more degenerate animals may be recognized by their paler color, weaker horns and thinner fur. Of eleven captured by Strahlborn in 1858, four were of the pallid, thin-haired, degenerate type. Another indication of the degenerate condition of the Bieloviejsha herd is seen in the great excess of bulls, which probably outnumber the cows two to one. This is doubtless a result of in-breeding, for Düsing (Jena Zeitschr. für Naturwiss, Bd. XVII., p. 827, 1884) has shown that close in-breeding, like a reduced condition of nutrition, is favorable to the production of an excess of males. Thus the total extinction of the Bieloviejsha bison is certain to occur, and that probably in the near future. Such a fate the author points out overtook the last herd of *Bos primigenius* in Poland during the early part of the seventeenth century, notwithstanding the most careful protection.

In conclusion, the author considers that his studies of the history of the Bieloviejsha bison leave scarcely room for doubt that in-breeding is the cause of the final extinction of most large mammals. In-breeding must begin and lead gradually but certainly to the extinction of a species when it, through any cause, has become so reduced in numbers as to be separated into isolated colonies.

If Büchner's conclusion is correct—and few will doubt that it is—we may look for the speedy extinction of the American bison, whatever means may be taken for the protection of the few remaining individuals, while the danger attending any considerable reduction in the size of the Pribilof Island seal colonies, with the expectation that they will regain their former size under subsequent strict protection, becomes fully apparent.

GERRIT S. MILLER, JR.

DENTITION OF LEMURS AND THE SYSTEMATIC POSITION OF TARSIUS.

IN a recent number of SCIENCE appeared an abstract by Prof. A. A. W. Hubrecht, of his contribution to Gegenbaur's *Festschrift*, giving his conclusions upon the relations of Lemurs and monkeys, especially upon the position of *Tarsius* among the Anthropoidea. It is interesting to find, in the same collection of memoirs, a contribution from

Prof. Wilhelm Leche, of the University of Stockholm, upon the teeth of living and extinct Lemurs, in which different conclusions are reached.

He sums up his results as follows: "The observations brought together in the preceding sections include a number of facts which are of general significance and which may be of general service. During the Eocene and Oligocene periods, Europe and North America were inhabited by groups of Lemurs, which contained a number of genera distributed in both hemispheres. During the Oligocene every trace of these Lemurs disappeared in the northern hemisphere, and we find no traces of these animals until they reappear among the existing forms of the Ethiopian and Indian regions. To our complete ignorance of the Lemurs during the long intermediate period is added the fact that at first sight the modern Lemurs appear to be a group widely different genetically from those of Eocene times. Yet, as I have endeavored to demonstrate above, the difference between the living and extinct Lemurs is by no means so great as it is generally supposed to be. Among the old Tertiary forms the strong differentiation of the teeth in the anterior portion of the jaw, which characterizes the living forms, had not arisen. Yet even in these older forms we see certain indications which point towards such a differentiation. Notably supporting such a conclusion are the discoveries in the milk dentition of weight.

"Until we obtain further knowledge, as above stated, we must distinguish two groups of extinct Lemurs, the most complete representatives of which are *Adapis* and *Microchærus*.* In spite of all the differences between these two groups, there are, nevertheless, exhibited a number of common characters, in which they together appear to present a more primitive constitution than any of the living Lemurs. To select a single illustration, among the older tertiary Lemurs we still find four premolars and three upper incisors, while in the living forms we never find more than three premolars and two upper incisors.*

"Among the living forms we have certainly to distinguish two groups, the *Lemuridæ* and *Tarsiidæ*, the latter uniting most closely with *Microchoerus* and its related forms. Now, while the modern *Tarsius*, in important parts of its structure—in the structure of its placenta, in the structure of its orbit and in the straight colon—certainly has taken a different developmental direction from the remaining Lemurs and deserves an isolated position, nevertheless, its milk dentition shows such a close approach to that of the true Lemurs that a common derivation of the *Lemuridæ* and *Tarsiidæ* must be considered as at least highly probable. For the hypothesis which I have endeavored to establish in my earlier work, that the milk teeth are to be regarded as the representatives of an earlier developmental phase, with more primitive characters than the permanent teeth, we find that the teeth of the Lemurs lend a number of supporting features: First, in *Hapalemur* the superior incisors have a more normal position in the milk dentition than in the permanent dentition. Second, the second upper premolar of *Adapis* has retained the original premolar form more completely than its permanent successor. Third, the lower incisors of the Lemurs are somewhat less modified than their successors. Fourth, the second lower premolar of the Lemurs has, as is well known, taken on the form of a canine, while the milk tooth correspondent to this retains the more ancient premolar form. Fifth, in the *Indrisinæ* and in *Chiromys* the milk dentition retains almost

*Prof. Leche considers *Necrolemur* Filhol. as equivalent to this form.

* Prof. Leche has evidently overlooked *Anaptomorphus*.

the complete typical formula, while the permanent dentition shows a very marked reduction. Also in *Lepidolemur*, in which all the superior permanent incisors are wanting, one incisor is preserved in the milk dentition.

"Almost without exception the milk teeth of the Lemurs are smaller and weaker than the corresponding permanent teeth. If the permanent dentition reaches a higher grade than the dentition it is explained by the fact, as I have already shown, that the latter has undergone a more or less pronounced differentiation in the size of its individual components; this is the case in *Tarsius*, *Indrisinæ* and *Chiromys*, without in the least diminishing the original number of the teeth.

"So far as I have considered the phylogeny of the different teeth, whilst among the Insectivora and the mammalia of the secondary period, and in exceptional cases among the living forms such as the Marsupial *Choeropus* and the fossil *Paleochoerus*, canines are observed with double roots—a character which is certainly to be regarded as primitive—I have found in the Lemurs, both in the milk and permanent dentition, two-rooted canines. The fact that often a one-rooted milk canine is replaced by a two-root permanent canine, and this order in other cases is reversed, requires further clearing up.

"That an elongate or more premolar-like structure of the superior canine is the original form of this tooth in the Lemurs, appears to be evident in every case in which the permanent canine differs from the milk canine; for the milk tooth is always more like a premolar than the permanent tooth, as seen in the comparison of *Chirogaleus*, *Adapis* and *Tarsius*. A comparison of the canine of the old tertiary form, *Microchoerus*, with that of the modern Tarsius, lead us to the same results."

H. F. O.

CURRENT NOTES ON PHYSIOGRAPHY.

ORIGIN OF THE LAURENTIAN RIVER SYSTEM.

UPHAM continues his discussion of the great lake problem (Amer. Geol., XVIII., 1896, 169–177), maintaining that during Tertiary time the Mississippi-St. Lawrence divide probably lay northwest of the Adirondacks, in this differing from Spencer, who regards the preglacial St. Lawrence as already an extensive river system. Certain general relations of our larger land forms and river systems would, however, seem to prove the extension of the preglacial St. Lawrence at least into the Ontario basin. All the Great Lakes, except Superior, lie along the inner lowlands, and are enclosed by the infacing uplands* of an ancient and greatly denuded coastal plain of paleozoic strata, whose oldland is the Laurentian highland. The great Appalachian valley is also an inner lowland, between the inface of the Alleghany and Cumberland plateau and the oldland of the Blue Ridge; but this inner lowland is complicated by the mountains that have been bent up and worn down along it. The normal drainage of both these regions would be from the oldland across the inner lowland and out through the scarped uplands to the Ohio or Mississippi. The Wisconsin and the Kanawha rivers are exceptional in still preserving this normal course. The Potomac, Susquehanna, Delaware and Hudson are all abnormal in flowing from the Alleghany plateau across the inner lowland and out through the oldland to the Atlantic. Now, as these abnormal courses had been attained in early Tertiary time, and perhaps sooner, it is not only possible, but probable, that a considerable part of the abnormal drainage area of the St. Lawrence had been developed much earlier than Upham maintains.

* The Spanish term *cuesta* might be used for this unnamed form. See Hill, Nat. Geog. Mag., VII., 1896, 295.

THE EARTHQUAKE WAVE IN JAPAN.

The recent earthquake wave on the northern coast of Hondo, the chief island of Japan, is vividly described with illustrations by E. H. Scidmore (Nat. Geogr. Mag., VII., 1896, 289). The wave reached the coast in the evening of June 15th, last. Most of the people were indoors on account of rain then falling, "when, with a rumbling as of heavy cannonnading out at sea, a roar, and the crash and crackling of timbers, they were suddenly engulfed in the swirling waters." Only a few survivors on all that length of coast saw the advancing wave, one of them telling that the water first receded some 600 yards before the wave rose like a black wall 80 feet in height, with phosphorescent lights gleaming along its crest. "Ships and junks were carried one or two miles inland, left on hilltops, treetops, and in the midst of fields uninjured or mixed up with the ruins of houses." Where the coast was low and faced the open ocean, the wave washed in and, retreating, carried everything back with it. Where the wave entered a fiord or bay it bore everything along to the head of the ravine or valley and left the mass of *débris* in a heap at the end. On the open coast the wave came and withdrew within five minutes, while in long inlets the water boiled and surged for nearly half an hour before subsiding. Groves of large pines were cut down to short stumps; thick granite posts of temple gates were snapped off, and the stone cross-beams were carried 300 yards away.

GEOGRAPHICAL BIBLIOGRAPHY FOR 1895.

A geographical bibliography for successive years constitutes a supplement (5 fr.) to the five regular numbers of the Annales de Géographie (Colin, Paris, 25 fr.). The bibliography for 1895 is just issued with 1087 titles, the work of 49 co-laborers. It is arranged under the following chief headings: history of geography, mathematical, physical, political geography and regional geography; this last being much further divided under subheadings of different countries. Brief notices are given of more important work, but with less detail than in Petermann's Mitteilungen. An index of authors cited occupies 23 columns. A three-hour cursory examination of such a work as this will guide most librarians to all the geographical works that they need order. A somewhat more careful examination will disclose many out-of-the-way essays to the scientific reader; for example, an article by Carton on '*Oasis Disparues*' (Rev. Tunis, 1895, 201), maintaining that the climate of Tunis has not changed since Roman times, that careless waste of water to-day contrasts with careful economy in ancient times, when reservoirs and canals fertilized the oases.

NOTES.

The testimony of 'old residents' as to the reputed change in the range of vision in the Swiss Jura, supposed to be the result of earth movements, and given some credence by extended quotation in recent years, has been carefully examined on the ground by Jegerlehner, who doubts its sufficiency. He does not find the memory of untrained observers a sufficient argument to so remarkable a conclusion, and recommends the establishment of accurate measurements, which are probably now in progress (Jahresber. Geogr. Ges. Bern, XIII., 1894, 15–22).

Früh discusses the terminology of valleys in the Jura and Swiss Alps (Zur Kritik einiger Thalformen und Thalnamen der Schweiz, Viertelj. Naturf. Gesellsch., Zurich, XLI., 1896, 318–339). *Combe* applies to various forms, and is variously defined by such writers as Sonklar, Sievers and Reclus; and hence it does not deserve the specific meaning given to it by Desor.

Früh regards it as equivalent to *Kumm* and *Gummi* in the Alps, and to *Cwm* in Wales, and refers all these modern forms to an Indo-Germanic root, meaning valley, preserved to-day in rugged districts where the the older races sought refuge from invaders. *Ruz*, *cluse*, and other terms are similarly discussed.

A CIRCULAR issued by Domenico Locchi, Via Cibrario, 47, Turin, Italy, describes a model of the morainic amphitheatre of Lake Garda, which he constructed on order of the *Scuola di Guerra* at Turin. It is highly spoken of by the commander of the school and by so competent a geological critic as Prof. Taramelli, of the University of Pavia. A photographic print of the model shows it to be a remarkably fine illustration of a great looped moraine. The cost of the model is 250 lire, boxing extra. Its horizontal scale is 1: 25,000; the vertical scale being 2½ times larger; its dimensions are 1.70 by 1.60 m. A list of other models by the same artist may be had on application to him.

A REPORT on the erosion of English coasts made to the British Association (1895, 352–392) records an average annual recession of 5 feet 10 inches for 37 years on the clay coast of Yorkshire from Bridlington to Spurn Head. Piers built at Dover and Folkestone catch the drifting shingle, and thus deprive the cliffs beyond of their natural protection, making costly seawalls necessary. Besides several reports from local observers, there is a local bibliography.

CURRENT NOTES ON METEOROLOGY.

CLIMATE AND MAN.

THE word anthropo-geography has been coined to meet the need of a designation for that branch of geography which treats of the earth in its relation to man. The present rapid advance of climatology has in the same way rendered necessary the coining of a similar word which can be used to designate that aspect of this study which deals with the relations of climate and man. It is natural that the word *anthropo-climatology* should be chosen for this sub-division of our subject. The length of the term makes it rather clumsy, yet its advantages more than outweigh its disadvantages, and it is to be hoped that it may come into general use. Under anthropo-climatology we should include all the various relations that exist between climate taken in its broadest sense and man. The climatic control of habitability, of occupation, of colonization; the influence of climate in stimulating or controlling migrations, invasions, and the like; the immediate and permanent physiological effects of different degrees of temperature, humidity and pressure, etc.; the relation of climates to the distribution and prevalence of diseases; acclimatization, and other related matters may all find shelter in this subject of anthropo-climatology. To some extent also, in considering the medical or sanitary aspect of climatology, some account must be taken of soil conditions, of ground water, of drainage and other matters which are usually included under the head of hygiene. Anthropo-climatology thus considers subjects which belong in many other departments of learning. It embraces within its scope matters that come up also in meteorology, geography, medicine, hygiene, history, ethnology. At present this human side of climatology receives little attention, but it is certain to become a subject of increasing importance as time goes on. Its consideration belongs properly under climatology, and instruction in climatology of a university grade should lay more emphasis than it now does on these interesting and important relations of climate and man. The student of anthropo-climatology must gather his information from many sources. He must consult writings of all the subjects above mentioned as contributing to this

subject, but anyone who is alive to its importance, and who reads with his eyes open, will not fail to find abundant material.

KITE METEOROLOGY.

THE literature of kite meteorology is increasing at a rapid rate, and even now anyone who wishes to be well informed in regard to this interesting subject will find that there is a good deal of reading to be done. As has already been stated in these notes, Prof. C. F. Marvin, of the Weather Bureau, has been giving a large share of his time to the development of scientific kite-flying, and the United States at present enjoys the distinction of being the only country whose weather service has officially undertaken such a piece of work. That Prof. Marvin's investigations have been very thoroughly carried on is shown in a series of articles he has written for the *Monthly Weather Review* for April, May, June and July, 1896, in which the results already attained are set forth. These articles taken together make the most complete and most elaborate publication yet issued on the subject of scientific kite-flying. The details of kite construction, the best materials for kites and cord, the analysis of the forces acting on the kites, the calculation of the heights attained, and other matters, are considered, and many illustrations accompany the text.

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CURRENT NOTES ON ANTHROPOLOGY.

THE GERMAN ANTHROPOLOGICAL SOCIETY.

THIS Association held its twenty-seventh annual session in August, at Speier. Prof. Virchow delivered the opening address, largely concerned with the craniology of German prehistoric graves. Most of the papers were local in character, on the Archæology and Ethnography of Central Europe. Exceptions to this were, one by Dr. Hagen, on the Papuas of New Guinea; by Dr. Ranke, on Fossil Men; by Baron von Andrian, on Word-Superstitions, and by Prof. Virchow on Criminal Anthropology.

In the last mentioned the distinguished German professor pointed out the errors in Lombroso's theory, which he compared with phrenology in its arbitrary and unscientific character. Dr. Ranke sketched the physical traits of the earliest men. They had one type. They were 'eurycephalic' (the brain-skull large in reference to the face, the face-skull small); their color was yellowish; the hair coarse; the base of the skull oblique; the third molar rudimentary. He believed they originated in Asia. Dr. Waldeyer discussed men with tails. He had microscopically examined one instance and found the tail just like that of a hog, that is, not bony, but cartilaginous, with nerves, arteries, etc. He thought the wonder is, not that men occasionally have tails, but that they are ever without them!

The next meeting of the Society will be held at Lubeck.

EARLY MEDITERRANEAN CULTURE.

THE address of Mr. Arthur J. Evans, President of the Anthropological Section of the British Association this year is peculiarly rich in new facts and suggestions.

He returned but a few months since from his third archæological exploration of the island of Crete and brings back with him ample evidence of the intimate contact of the natives of that island with the culture of Egypt probably as early as 2500 B. C.

No doubt the rays of this primitive insular civilization shone athwart the middle sea to the isles of Greece and the northern shores. But not on them alone did the wise of the race depend. Mr. Evans points out that the Mycenean culture of pre-Homeric days probably sprang from roots which we must seek in the soil of Anatolia, in that

Ægean art which developed in the favored vales of Phrygia and Lydia.

Other questions, of broader scope, are also touched upon by Mr. Evans. Dismissing the 'glamour of the Orient,' rejecting the orthodox notion that the primitive Aryan was some sort of a 'patriarchial missionary of Central Asian culture,' he declares for the greater probability that what the Aryan knew he had learned by study on the spot, and that his lineage is to be traced in European or 'Eurafrican,' surroundings from far back into the darkness of paleolithic times. Even then, in that rude and distant period, he was not of the brutes, brutish; for Mr. Evans relates an unpublished find of a surface burial, dating from Quaternary times, where the corpse had been laid in a position of decent repose, the shell knife, the deer's tooth ornaments and the paint pot by its side.

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ASTRONOMICAL NOTES.

DR. SEE'S recent discovery of a companion to Sirius has been followed by observations at the Lick Observatory, according to a letter received from Prof. Holden. Profs. Schaeberle and Aitken, observing with the 36-inch, find the position angle of the companion to be about 189°, while Dr. See, Mr. Douglass and Mr. Cogshall, observing with the large telescope of the Lowell Observatory, found 220°. As Dr. Auwers's ephemeris in *Astronomische Nachrichten* No. 3085 gives 176° for this position angle, it is evident that the whole matter will require further elucidation.

THE Saxon Academy of Sciences has published an extended paper by Dr. J. Hartmann on eclipses of the moon. It forms a sequel to the same astronomer's well known work on the best value of the moon's diameter to be used in the prediction of lunar eclipses.

H. J.

SCIENTIFIC NOTES AND NEWS.

SCIENCE, DEMOCRACY AND THE UNIVERSITY.

PROFESSOR WOODROW WILSON'S oration at the Princeton Sesquicentenial Celebration was admirable as a work of literary art; but as an official address, representing the policy of a great college aiming to become a university, it challenges criticism. Professor Wilson chooses his words carefully and enters caveats against his own conclusions. But on the whole he advocates the monastic ideal for a university; he mistrusts modern democracy and deplores modern science. For him the university is "a place removed—calm Science seated there, recluse, ascetic, like a nun, not knowing that the world passes, not caring if the truth but come in answer to her prayer; and Literature, walking within her open doors in quiet chambers with men of olden time, storied walls about her and calm voices infinitely sweet; here 'magic casements opening on the foam of perilous seas in fairy lands forlorn,' to which you may withdraw and use your youth for pleasure."

For us Science is no 'recluse, ascetic, like a nun,' 'doing us a great disservice, working in us a great degeneracy when it mingles in the affairs of the modern world.' If we must choose a mediæval simile, Science is rather Dürer's Knight, firmly seated on truth, not minding death greatly, looking forward without fear, ready to aid and, if need be, to kill. The democracy of to-day has been made possible by science, and science will control its future. We are not ashamed of the alliance; it is better for some men to think unwisely than for most men not to think at all. Progress can only result from variations, and favorable variations cannot occur apart from such as are harmful. We do not retire from the world to use 'our youth for pleasure' and our age for contemplation. We stand as leaders amidst a conflict whose outcome we shall decide.

Professor Wilson tells us that "the world's memory must be kept alive, or we shall never see the end of its old mistakes. We are in danger to lose our identity and become infantile in every generation. That is the real menace under which we cower everywhere in this age of change." Such utilitarianism is futile. We are the past; it is alive in us and in our envir-

onment, not stored away in our libraries. Many would find life empty without its inherited wealth of literature and of art, but the function of these is as much to make us forget as to make us remember. If the past could not develop into a present better than itself, it would ill deserve our study and imitation.

Our ideal of a modern university is not a place where the walls of the colleges crumble while the dons drink their port. Rather we admire William Morris, who would leave that place and carry into the midst of the common people the best of literature and of art. True culture comes not from the elaboration of self, but from the devotion of self to useful work. Professor Wilson would have the modern university 'a place removed,' looking 'towards heaven for the confirmation of its hope.' We like to see the modern university in the midst of men, looking towards earth, that it may learn and teach.

ACADEMIC FREEDOM IN RUSSIA.

We referred recently to the enforced retirement of Prof. Erismann (Jerismann) from the University of Moscow. The Russian correspondent of the *Lancet* gives some details from which we may quote.

The facts are briefly as follows: Political disaffection, or rather dissatisfaction with the present *régime* in Russia, with its anomalies and not-infrequent injustices, is not rarely met with among the students of Russian universities. Wherever it is met with it is put down with a very stern hand. Sometimes, however, it happens that the not unnatural aspirations of the students find sympathy and support from the professors. This was the case two years ago in the University of Moscow. A petition was at that time drawn up and signed by forty-two of the University professors and then presented to the authorities. The petition drew attention to certain wrongs suffered by the students, to the harmfulness of the system of so-called 'administrative exile' (that is to say, exile for political opinions without any reasons being given for the exile and without opportunity of appeal from the sentence), and to the fact that the present University Court, or governing body of the University, which is appointed entirely by the government and not elected by the professors, cannot in all cases be just to the students. The only result of this petition was a formal censure, from the government, of all the forty-two professors who had signed it and a severe reprimand to four, of whom Prof. Erismann was one. The reasons of Prof. Erismann's enforced resignation of his chair are not at present publicly known, but there is little cause to doubt that the incident just narrated—or, rather, the 'liberal' leanings of Prof. Erismann, of which the incident was, perhaps, one out of many proofs—were the real reasons. This explanation, which is the one most generally accepted, is further supported by the rumor that two of the other three professors who were reprimanded at that time have also been requested to resign their chairs. The circumstances of Prof. Erismann's resignation were the following: It is the custom of the Russian government every summer to send a certain number of professors to foreign countries to study foreign methods and systems and so to keep in touch with the progress made in other countries. Among those sent this summer was Prof. Erismann. He visited Berlin and then went to Switzerland. While there he was officially informed that his services in the chair of hygiene were no longer needed, the retirement to date from July 1st. No reasons were given, but three days were allowed during which a voluntary resignation would be accepted.

Prof. Erismann is eminent for his contributions to hygiene and the study of epidemics, and had organized and equipped fine laboratories of pathology and hygiene in the University of Moscow. He was president of the recent Russian Pirogoff Congress, and was to have been general secretary of the International Congress to be held in Moscow next year.

SYSTEMATIC ZOOLOGY.

The editor-in-chief of the *American Naturalist* is a distinguished representative of the union of extensive research in systematic paleontology and zoology combined with wide biological and philosophical interests. We quote from an editorial article in the *Naturalist* an answer to certain captious criticisms of those engaged in the

study of species which have recently appeared in *Natural Science* and in the *Revue Scientifique:*

"We regard the expressions above quoted as an indication of a mild form of megalomania which is not unfrequently found among the users of mechanical appliances in the biological laboratory. The most intelligent cultivators of these important branches of biologic research are, however, well aware that the exact determination of species is fully equal in importance to their own pursuit, for the following reasons, among others: If we regard biology to consist of two branches, evolution and physiology, we define evolution, with Darwin, as the origin of *species*. For physiology the question of species is not so important. Species are, however, what the labors of the ages have produced, and it is necessary to know them in order to pursue any branch of evolution (as embryology or paleontology) intelligently. The work of the embryologist and paleontologist who does not know the species whose origin he seeks to explain is greatly lacking in precision. Linnæus states that the tyro knows the higher divisions, but only the expert knows species. We also especially deny that the discrimination and description of species is within reach of the most mediocre intelligence. On the contrary, no kind of work in biology imposes as much on all the mental faculties which are used in scientific work. Those who have not attempted it have little idea what is involved in a diagnosis or an analytical key. Finally, as regards the mammalogic work of Messrs Merriam and Miller, we consider it of the utmost importance. They are pointing out the results of the evolution of Mammalian life in North America, which it is the business of the embryologist and the paleontologist to explain. And in this field the work of Messrs. Merriam and Miller is the best that has ever been done in any country."

GENERAL.

DR. J. A. HUGO GYLDEN, director of the Astronomical Observatory at Stockholm and professor of astronomy at the University, died on November 9th at the age of fifty-five years.

THE seventieth birthday of Dr. Stanislas Cannizzaro, professor of chemistry at Rome, will be celebrated on November 21st, by the presentation of a gold medal, of congratulatory addresses and of a fund to be used by him for the advancement of chemistry.

THERE will be held at Washington a memorial meeting in honor of the late Dr. G. Brown Goode. Hon. Gardiner G. Hubbard is Chairman of the Committee of Arrangements.

WE learn from *Die Natur* that a monument in honor of K. Th. Liebe, who had made important contributions to geology and ornithology, especially in Thüringen, was dedicated in Gera on October 18th.

THE hundredth anniversary of the birth of the eminent anatomist, anthropologist and naturalist, Anders Adolf Retzius, was celebrated with suitable ceremonies at Stockholm on October 13th.

THE municipality of Paris has changed the name of the Boulevard de Vaurigard to that of Boulevard Pasteur.

THE Berlin Academy of Sciences proposes, as the subject for the Cothenius prize, 'Experiments and observations on the origin and behavior of new varieties of grain during the past twenty years.' The paper, which may be in Latin, German, French, Italian or English, must be presented before the beginning of the year 1899. The prize is of the value of 2,000 M.

MR. R. ETHERIDGE has been awarded by the Royal Geological Society of Cornwall its first Bolitho gold medal.

THE Committee on Science and Arts of the Franklin Institute, of Philadelphia, have awarded the John Scott medal for 1896 to Emile Berliner, of Washington, D. C., for his invention, the gramophone, it being, in their opinion, an invention of great merit and usefulness.

THE managers of the Royal Institution, London, have appointed Prof. A. D. Waller, M. D., F. R. S., to be Fullerian professor of physiology for three years, and Dr. A. Scott to be superintendent of the Davy-Faraday Research Laboratory. The Christmas lectures specially adapted for children will this year be be given by Prof. Silvanus P. Thompson, F.R.S., his subject being 'Visible and Invisible Light.'

MAJOR J. W. POWELL will give at the Catholic University a course of six special lectures, reviewing the scope of anthropology and taking up savagery, barbarism, primitive civilization and modern civilization.

FURTHER details regarding the Nansen research fund now being raised in Norway, are quoted by *Nature* from the *Times*. Its object is to commemorate the remarkable Arctic expedition of this explorer by the foundation of a fund called 'The Fridtjof Nansen Fund' for scientific research. It is intended that, by this means, research in various departments of science shall be promoted, and the results published. Dr. Nansen himself may be appointed director, but there will be no salary attached to the office, as the whole of the yearly products of the fund will be devoted to the objects stated. Up to the present no less than 300,000 kroner have been subscribed. Consul A. Herberg, Dr. Nansen's friend, has contributed 50,000 kroner; while others, besides numerous Norwegians, are Baron Oscar Dickson, 25,000 kroner; and Prof. Frankland, 1,000 kroner. It is stated that the fund will probably be placed under the care of the Christiania University, the Norwegian Society of Science, and the Bergen Museum. If any who are admirers of Dr. Nansen care to contribute they should communicate with the Committee of the 'Fridtjof Nansens fond, University of Christiania.'

THE London *Daily Chronicle* published, on November 3, 4 and 5, a detailed and elaborately illustrated series of articles by Dr. Nansen, describing his adventures in the extreme north. The articles have been extensively copied in the daily papers and are of dramatic rather than of scientific interest. Dr. Nansen received about $20,000 for these articles, and will receive about $50,000 for his book. The scientific results of the expedition will be presented before the Royal Geographical Society, and doubtless will be published in a suitable form and place.

THE Associated Press reports that Messrs. D. G. Elliott and C R. Aikley, of the Chicago Field Columbian Museum, left Southampton on November 14th, on their return to the United States, after a very successful expedition into Somaliland. Mr. Elliott states that the collections are of great value, 58 cases having been shipped from Aden to Chicago.

MR. R. P. CURRIE, of the United States National Museum, left New York on November 14th, ult., for Hamburg, on his way to Liberia, where he will spend several months collecting zoological specimens. He will devote especial attention to insects showing protective mimicry.

Nature quotes from the *British Central African Gazette* news of the return of Mr. Alexander Whyte, Sir Harry Johnston's scientific assistant in British Central Africa, from a successful expedition into the Nyika plateau, on the north-eastern shores of Lake Nyasa, where he has made a large collection. The flora of this district proved to be most interesting, resembling that of Mount Milanji, in the south of Nyasaland, but differing from it in many respects. Mr. Whyte failed to find any trace of a conifer, but the range is richer in heaths than Milanji. He obtained 6,000 specimens of plants and a large zoological collection.

PROF. KOCH has been sent to South Africa by the German government to investigate the causes of the *Rinderpest*.

DR. L. A. BAUER, who, as we have already announced, is undertaking a magnetic survey of Maryland, under the recently established State Geological Survey, has taken observations at about 40 stations, or one for about every 250 square miles, which gives Maryland the most detailed magnetic survey yet undertaken in America.

HOUGHTON, MIFFLIN & Co. have in press 'The Life and Letters of Dr. William Martin Rogers,' prepared by Mrs. Rogers, with the assistance of Prof. W. T. Sedgwick.

LOTZE'S *Medicinische Physiologie*, published in 1852, may be regarded as the pioneer work in modern physiological and experimental psychology. It has long been out of print, but a reprint is now announced by the Diedrischen Buchandlung, Göttingen.

AMONG the large number of books announced by the Clarenden Press, Oxford, as in active preparation there is apparently only one in the

physical and natural sciences: 'Practical Work in Electricity and Magnetism,' by W. G. Woollcombe.

A NEW *Bericht* will hereafter be published by the Nordoberfränkischer Verein for natural history, located at Hof, Bavaria.

MR. ANDREW CARNEGIE has let the contract for building a free library at Homestead at once, and will immediately prepare for similar institutions at Duquesne and Carnegie. He has announced that he will found as many branch libraries in Pittsburg as may be needed.

IT is stated in *Nature* that the objects exhibited in the ethnographical section of the Millennial Exhibition at Budapest are to be used as the nucleus of an ethnographical museum. The collection of machines in the special exhibition of the means of transport are to form a railway museum, and the bulk of the exhibits in the agricultural section will be used for the foundation of an agricultural museum.

The Astrophysical Journal announces the establishment of a new astrophysical observatory at Rössgen, Mittweide, Saxony. The principal instrument, which was to be ready for use by the middle of October, is a refractor of 170 mm. aperture, made in the workshop of Hans Heele, in Berlin. It is provided with both visual and photographic objectives, and the mounting embodies a number of new features. The program of the work prepared by Dr. Friedrich Krueger, the director of the observatory, includes: (1) The formation of a photometric catalogue of all colored stars within the limits of the director's catalogue of colored stars. (2) Photometric determinations of comparison stars used in the observation of variables, including such stars as are communicated to the director by observers of variables and those which are found in published papers. (3) Construction of star charts by the aid of photography of regions containing variables.

WE called attention to the celebration this year of the 150th anniversary of the Zurich Scientific Society. The Society has now issued, in commemoration of the event, two volumes edited by Dr. F. Rudio, with the cooperation of Drs. A. Heim and A. Lang. The first volume contains a history of the Society with portraits of some of its distinguished members, and the second volume contains scientific papers.

IT is stated in *Cosmos* that the International Geodetic Congress, which met recently at Lausanne, under the presidency of M. Faye, received reports on the organization of the projected four international observatories for the study of small movements of the earth's axis. The statutes adopted last year at Berlin have been ratified by fourteen of the twenty-one states taking part. The ratification of the remaining seven is expected before the close of the year.

THE Massachusetts State Board of Agriculture will hold a public meeting at Greenfield on December 1st, 2d and 3d, when a number of interesting papers will be read. It is expected that the question of prosecuting the work of the extermination of the gypsey moth will be prominently brought forward.

AT the Convention of the Agricultural Chemists of the United States, held recently at Washington, officers were elected as follows: President, William Frear, Pennsylvania; Vice-President, A. L. Winton, Connecticut; Secretary, H. W. Wiley, Washington, D. C.; Executive Committee, B. W. Kilgore, North Carolina, and Arthur Goss, New Mexico.

A CONGRESS of Medical Climatology and Hydrology, to be held at Brussels in connection with the exhibition of 1897, is being organized under the auspices of the Belgian Royal Society of State Medicine.

THE Paris Society of Hypnology and Psychology has decided to hold an International Congress of Experimental and Therapeutic Hypnotism in Paris in 1900.

THE repeal of the law practically forbidding the use of motor carriages in Great Britain was celebrated on November 14th by a race from London to Brighton. Fifty carriages took part in the race, it being won by a Duryea motor, which traversed the distance of 47 miles in four hours.

PHYSIOLOGICAL effects caused by the Röntgen rays were, we believe, first reported in this

JOURNAL (April 10, 1896), by Prof. John Daniel. It was at the time regarded as extraordinary by others working with the Röntgen rays, but has since been fully confirmed. Cases of loss of hair, of finger nails and of dermatitis have been reported, and physicians making use of the rays should be careful that the time of exposure is not too long and that the vacuum tubes are not brought too near the body.

IT is stated in *Electricity* that Herr Dormann, of Bremen, has succeeded in photographing objects, by Röntgen's method, through iron plates 22 centimeters thick. He has already taken more than fifty such photographs.

IN their reports of the recent elections the daily papers almost failed to notice that the forestry amendment to the Constitution of the State of New York was defeated. This amendment permitted the leasing of small plots and certain exchanges and sales of land, and its defeat is gratifying to those interested in the forest preserve. Even the placing of the reservation under a system of scientific forestry management, as advocated by *Garden and Forest*, seems questionable. Part of the preserve might be so treated, if it were possible to depend on the good faith of the management, but there are many reasons, some of them of considerable scientific importance, for allowing part of the preserve to remain as primeval forest.

THE *Nation* says: "The recent adverse decision of the Court of Appeal at Rouen in the now famous case of scientific plagiarism, Cremieux-Jamin *vs.* Lombroso, reinforces a good idea that comes from Prof. Michael Foster, Secretary of the Royal Society. Prof. Foster suggests an international organization of scientific men for the purpose of registering at frequent intervals the results of contemporary investigation. Such a body would serve not only to protect the investigator from prosecution, but also to prevent him from going over ground already trodden. For the world of science at large, it could perform a valuable service by discriminating what has become common property from what is still in the possession of the original author." The *Nation* may know of some plan other than that of the recent International Bibliographical Conference. But it is not evident what 'valuable service' a body would perform 'by discriminating what has become common property from what is still in the possession of the original author.'

OEDAM, the head Sundanese gardner in the Botanic Gardens of Buitenzorg, Java, has just been decorated, by the government of Netherlands India, with the *Zilveren Ster van Verdienste* (Silver star of merit), as a tribute to over 50 years of faithful service in the Gardens. The decoration services and the presentation address in Malay, by Director Treub, took place on the 16th of September, with all the befitting ceremony so agreeable to the natives. This is the first time the silver star, which is strictly designed for native civil employes, has been accorded to one of the native gardeners. Every botanist visiting the Gardens comes to know and appreciate the value of this old man's astonishing knowledge of tropical plants. His acquaintance not only with the scientific and native names of the plants, but his acute sense of their natural relationships has made his services of inestimable value. He is a member of one of those native families from which the Gardens have drawn so many of their best collectors and gardeners. His father occupied the position of chief overseer or mandor of the coolies under the directorship of Dr. Teysmann, and his son has already fitted himself to fill the position of chief gardener, or *mantri*, on his father's retirement. This is probably the highest tribute ever paid to Sundanese botanical intelligence. D. G. F.

IN a recent paper on the distribution of certain mammals in New England and northern New York, Mr. C. F. Batchelder notes the direct connection between agriculture and the distribution of the red-backed mouse (*Evotomys gapperi*), a species eminently characteristic of the Boreal zone. This species is chiefly found in New England in sphagnum swamps, and as these are drained the animal is deprived of the territory suited to its needs. In Cape Cod of late years the cedar swamps have been stripped of their trees and turned into cranberry bogs to such an extent that, if this industry should increase but a little more, there is every proba-

bility that *Evotomys* would cease to exist within the limits of Barnstaple county.

UNIVERSITY AND EDUCATIONAL NEWS.

THE corner stones of the Havemeyer Hall of Chemistry and of the Engineering Building of Columbia University have been informally laid. The buildings are already further advanced than might be supposed from the fact that the corner stones have just been laid, and it is hoped that these, as well as the Library, Schermerhorn Hall for the Natural Sciences and the Physical Building, will be ready for occupancy in the summer of 1897. The excavations, which are the most extensive hitherto undertaken in New York, for the University Hall are nearly completed. This building will contain the Academic Theatre, the Gymnasium and the Dining Hall.

THE Yale Alumni Association of California, following the example of the Harvard Alumni of the same State, has established a graduate scholarship at Yale University, yielding an income of $300, to be awarded to a graduate of one of the California colleges on nomination by the Association.

THE present registration at the University of Pennsylvania now amounts to 2,752, which is a gain of 130 over last year, although the requirements for admission have been raised.

THE number of students in German universities last summer is reported to have been 29,802; in 1895 it was 28,709, so that the numerical increase for the present year is 993, or 3.5 per cent. The distribution of the students among the various universities was as follows: 4,649 in Berlin, 3,777 in Munich, 2,876 in Leipzig, 1,863 in Bonn, 1,425 in Breslau, 1,415 in Halle, 1,379 in Freiburg, 1,339 in Würzburg, 1,172 in Tübingen, 1,164 in Heidelberg, 1,138 in Erlangen, 1,007 in Göttingen, 965 in Marburg, 948 in Greifswald, 938 in Strassburg, 761 in Jena, 708 in Kiel, 700 in Königsberg, 630 in Giessen, 500 in Rostock, and 420 in Münster. The number of students at Vienna was 2,228, but only 1,370 of these were regular students.

THE Right Hon. Joseph Chamberlain has been elected Lord Rector of the University of Glasgow, having a majority of 234 votes over his opponent, Mr. Augustine Birrell.

DISCUSSION AND CORRESPONDENCE.

AGE OF THE ISLAND SERIES.

IN my paper on '*The Potomac Formation*' in the Fifteenth Annual Report of the United States Geological Survey, describing the section along the Raritan River, I remarked (pp. 335–336) that "from Morgan, the most easterly point, the formation may be traced northward across Staten Island and the northern shore of Long Island, and it reappears on Martha's Vineyard in the celebrated cliffs of Gay Head. * * * Along this most eastern line a new phase is seen, viz., the occurrence of concretions in the variegated clays, in the form of hard ironstones, which, when broken open, are found to contain vegetable remains in an admirable state of preservation. I am, therefore, disposed to regard these ferruginous, concretionary beds, extending from Staten Island to Martha's Vineyard, as the very latest phase of the Potomac formation, which I shall call the Island Series, although, from the similarity in the flora, I am disposed to include them, along with the Raritan and Amboy Clays, in the Albirupean Series."

Later in the same paper (pp. 373–382) the nature of the flora of this series was set forth, and it was shown that, so far as known at the time that paper was written, it consisted of 133 species, 52 of which were also found in the Amboy Clays, and the great preponderance of which were well developed dicotyledonous forms. The nearest affinities to these plants are afforded by the Atane beds of Greenland, which have always been correlated with the Cenomanian of Europe. Dr. Newberry regarded the Amboy Clays as representing that age and therefore as belonging to the Upper Cretaceous. In his monograph of the 'Flora of the Amboy Clays,' soon to appear posthumously, he gives his argument in full. He thought them of about the age of the Dakota Group. My opinion that they were somewhat lower, and should be placed at the summit of the Lower Cretaceous, having been called in question, I defended it in the paper referred to (pp. 373–374), as I think successfully. I had

never supposed that any one would attempt to place these beds lower than I had done, because it seemed impossible that such highly organized plants could have flourished earlier than the extreme upper portion of the Lower Cretaceous.

It is, therefore, a matter of the greatest surprise to me that Prof. Marsh should have discovered evidence which points to the Jurassic as the true date of the strata in question. His two papers on 'The Geology of Block Island,' published in the *American Journal of Science* for October (pp. 295–298) and November (pp. 375–377), are well calculated to stagger one who has been studying these deposits for eight years and who has visited all the exposures from the Raritan River to Nantucket, usually in company with Mr. David White or Dr. Arthur Hollick, and helped to make the extensive collections that they have yielded. It is true that until the present year I had not personally visited Block Island, but Mr. White was there in 1890, and his notes agree with my own later observations. Being a noted watering place I had naturally avoided it, and most geologists who have studied it have been chiefly interested in the glacial deposits that occupy its surface. But lying, as it does, directly in the line of the Cretaceous outcrop, and rising somewhat higher above the sea than most of the other islands, it was to be expected that the underlying clays would be exposed. I had long desired to see them, and in August last I requested Dr. Arthur Hollick, of the School of Mines, Columbia University, whose studies in this line, especially on Staten Island and Long Island, are so well known, to accompany me, and after making an excursion to certain critical localities on Long Island, including Montauk Point, we crossed to Block Island and spent three days in making a careful examination of all the exposures. We found the Cretaceous axis immediately. It originally occupied the northern half of the island. It is clearly visible at the north end of Grace Cove, on the west side of the island, but is best exposed below Ball's Point, on the east side. It has, as on Martha's Vineyard, a local dip to the northwest, due to the action of ice tilting it in the direction opposite to its normal dip. This, however, was not sufficient to prevent the Clay Marls, which immediately overlie these clays wherever conditions are normal, from coming into view on the south end of the island, and numerous exposures of these were discovered containing their characteristic molluscan fossils, of which a fair collection was made and submitted to Dr. Whitfield for identification. Fossil leaves were also found at many points, but they were usually too poor for safe determination. They were sufficient, however, to show that we were dealing with precisely the same beds as those of Gay Head, Long Island (Glen Cove), and Staten Island, which have yielded such a large flora, and, therefore, they belong to the Island Series. The characteristic red micaceous clay shales were identical with those found erratic all along the coasts of these islands, often where the clays themselves are below tide level. In Split Rock Cove, immediately east of Black Rock Point, the alternating red, black, and white clays, with a steep incline, simulate very closely those of Gay Head and leave no doubt that they represent the same conditions.

Prof. Marsh does not question the parallelism of all these beds, but refers them all to the Jurassic. He says: "An examination of both the Raritan and Staten Island clay deposits has supplied two links in a chain of evidence that I had not before known from personal observation. This chain now extends from the Potomac river to Martha's Vineyard, along the natural line of the Jurassic horizon, and indicates the Jurassic age of this series of strata beyond reasonable doubt."* In another place † he says: "The Raritan clays of New Jersey I regard as belonging to the same series as the Potomac beds." From these statements it seems clear that he regards the Potomac formation as representing one and the same horizon throughout, and believes that it is all Jurassic in age.

In his important paper just published in the Sixteenth Annual Report of the United States Geological Survey he figures a few Dinosaurs from the Potomac formation, but seems to include none that were not published by him in his paper in the *American Journal of Science* for

* Am. Jour. Sci., November, 1896, p. 376.

† Am. Jour. Sci., October, 1896, p. 296.

January, 1888. These were collected by Mr. Hatcher in an iron mine near Muirkirk, Md., associated with Sequoian cones and silicified wood. This horizon is now known to be the equivalent of the Basal Potomac of Virginia, and a rich flora of ferns, cycads and conifers has been discovered in it by Mr. Arthur Bibbins, which refers it without doubt to my Rappahannock series. From the date of this deposit to that of the Amboy clays, as I have shown, and *a fortiori* to that of the Island Series, there was an immense interval of time, and during that interval the flora completely changed. Only 15 species of plants out of 329 survived this period.*

The Potomac formation, therefore, while it is a geological unit, represents a great epoch in the history of the coastal plain, perhaps extending from the Jurassic below to the Cenomanian above, and occupying practically the entire Lower Cretaceous. It is thus to be compared with the Comanche series of Texas, and a mere reference to it without specifying which one of its six great subdivisions affords no idea of the position of any fossil that may have been found in it. The two lowest subdivisions, the James River and Rappahannock series, I have called the 'Basal Potomac.' It was of this portion of the formation that I treated in a paper read before the National Academy of Sciences in April 1888, and of which I said: "If the stratigraphical relations and the animal remains shall finally require its reference to the Jurassic, the plants do not present any serious obstacle to such reference."† I still stand by that statement, but when it is proposed to refer the 'Newer Potomac' also, with its great dicotyledonous flora allied to that of the Upper Cretaceous, to the Jurassic, the evidence for such a reference must be overwhelming. Indeed it may be questioned whether any amount of evidence from vertebrate remains would be sufficient to convince geologists generally. All geologists know that no dicotyledonous plant has thus far ever been reported with certainty from any formation lower than the Cretaceous. In my 'Sketch of Paleobotany'* this fact was clearly brought out, and in the eleven years of great paleobotanical activity that have elapsed since that paper apeared no discoveries have been made to modify it. It is true that I argued in that paper that the dictyledonous floras then known from the Middle Cretaceous, including our Dakota Group, were too highly developed to warrant the assumption that this class of plants had no earlier origin, and in my diagram (pl. lviii.) of the probable first appearance of the several great types of vegetation I projected the dicotyledonous column downward into the Jura-Trias The Older Potomac flora was then unknown, and its discovery has gone a long way toward justifying this claim. But in this, as I pointed out in the paper already mentioned,† the dicotyledons are rare, of strange aspect, embryonic, and prophetic of the great type of plant life that was to dominate the earth. Even in the Middle Potomac (my Aquia Creek series), which overlies the Rappahannock beds with some indication of unconformity, the dicotyledons are peculiar in character and are far outnumbered by the lower forms. Not so the great Amboy Clay flora. Here, and still more markedly the flora of Gay Head and Long Island, the dicotyledons are fully developed, many of them probably belonging to genera now found in our forests. They also make up the great bulk of the vegetation, and ferns, cycads and conifers are comparatively rare.

In a paper just issued and forming part of the Sixteenth Annual Report of the United States Geological Survey I have discussed the 'Earliest Dicotyledons'‡ and also certain 'Archetypal Angiosperms,' ⁋ and have reproduced figures of forms from the Jurassic that the late Marquis Saporta thought might represent, not dicotyledons, but ancestral angiosperms, prophetic of both monocotyledons and dicotyledons, which he called 'Proangiosperms.' I sympathize more or less with the point of view of the great French paleobotanist, and fully expect that forms will yet be found in the Jurassic which,

*Fifteenth Annual Report U. S. Geological Survey, p. 378.

†Am. Journ. Sci., 3d. ser., Vol. XXXVI., August, 1888, p. 131.

*Fifth Ann. Rep. U. S. Geol. Survey, p. 441, pl. LVI., LVII.

†Am. Journ. Sci., 3d. Ser., Vol. XXXVI., August, 1888, pp. 129–130.

‡Pp. 510–515. ⁋Pp. 535–536.

if they are not true dicotyledons, will prove to be their immediate ancestors. But I certainly do not believe that any number of well developed dicotyledonous plants will ever be found in the Jurassic, nor that such plants flourished at a period so remote.

Aside from the Carboniferous and the Miocene scarcely any geological age is better known from the botanical side than the Jurassic. From the Rhetic to the Wealden, rich Jurassic floras have been made known in many countries of Europe, in the arctic regions, in Siberia, in China and Japan, in India, Australia, South Africa and South America, and only last year the discovery was made for, the first time, of a true Jurassic flora in the United States, viz., near Oroville, in California.* Yet of all the hundreds of Jurassic forms thus brought to light not one is dicotyledonous.

In view of all this it is clear that there is no room for controversy over the age of the clays of Block Island or any of their equivalents. When the vertebrate remains that Prof. Marsh has found in these beds shall have been described, it will simply be a question of the relative weight that each one may choose to give to the two classes of paleontological evidence before the world. Many of the plants have already been published with full drawings and descriptions, and a list of them, which has since been considerably increased, is given in my paper on the Potomac Formation. Dr. Newberry's work on the 'Flora of the Amboy Clays' will soon appear as a Monograph of the United States Geological Survey, and Dr. Hollick is now engaged on a similar monograph of the flora of the Island Series. Those who are capable of supposing that such a flora as this could have flourished in Jurassic time are certainly at liberty to do so, and the geological world will doubtless duly appreciate their courage.

LESTER F. WARD.

WASHINGTON, D. C.

*See Prof. Fontaine's paper in the Am. Journ. Sci., for October, 1896, pp. 273–275.

THE DATE OF PUBLICATION.

IN SCIENCE for November 6th Dr. J. A. Allen objects to the resolution adopted by the Zoological Section of the American Association for the Advancement of Science at the Springfield meeting (1895), which recommended that the date of printing be regarded as the date of publication. He regards the position taken in the resolution as expressing both 'absurdity and mischievousness,' and insists that sale, or distribution only, constitute publication. He thinks that his opinion to this effect is a corollary of the definition given by the Century Dictionary, namely, that publication consists of 'the act of offering a book, map, piece of music, or the like, to the public by sale or by gratuitous distribution.'

The resolution was presented to the Section by a committee after consultation with many of the members who are engaged in scientific publications, and who are perfectly familiar with the subject in all its aspects. It was felt that, while it would be very desirable if a rule of distribution could be formulated, such a course is simply impracticable. The difficulty of so doing is set forth in the whereases that precede the resolution. Dr. Allen has not met these difficulties, but he adduces some objections to the adoption of the date of printing as that of publication. On the general position taken by Dr. Allen I make the following comments:

First. The date of printing, or alleged printing, of the last printed part of a book, the title page, has always been regarded as the date of publication. Who has ever inquired into or determined the date of sale or distribution of any scientific book published during the past, up to within a very few years? We are accustomed to refer to the title page, or last page, to ascertain this date, for further than that we cannot go. In most instances it will be impossible to ascertain the date of sale or distribution of books published in past years, apart from the date of printing.

Second. The probabilities are so great that a book is 'offered to the public' at the date affixed to it, that it is not safe to assume that it is not, except in two contingencies. The first is the case of fraudulent antedating of a book. This is likely to be of extreme rarity among scientific men, and if attempted would be easily detected by reference to the records of the printing office. The second case is the one brought forward by Dr. Allen, that of government pub-

lications which are issued at a date later than that which they carry on their title pages. This objection is not well taken, as stated by Dr. Allen, for, although some of the reports issued by our government may bear dates much prior to the dates of issue, it does not follow that the date of printing bears any such relation to the date of issue. They are, in fact, often printed as near the date of issue as are other books, the delay being prior to or during the printing. Here again the date of printing can be easily ascertained from the printing office. But in case of the detention of a book by the government subsequent to the printing, the question of the coincidence of the date of printing and of 'offer to the public' will depend on whether copies of the book can be had on demand or not. If the book can be had, it is 'offered to the public.' If it cannot be had, it is not offered to the public.

Third. The test of publication is according to Dr. Allen that it be 'offered to the public.' I agree with this, but hold that the only determinable test of date of offering to the public is the date of printing. The presumption is, that as soon as a book is printed and bound, it is offered to the public. That is the object of printing books. If the public does not buy or take what is offered, the duty of the publisher is fulfilled, the book is published just as much as though the edition were sold out in a day. How many copies must be sold or accepted in order to constitute a distributive publication? A single copy would constitute distribution, yet the scientific public might not be a whit the wiser for it.

Fourth. There is no doubt that the rule that the date of printing be regarded as the date of publication involves the difficulty which Dr. Allen cites as regards certain government books withheld from circulation though printed. However, these are really subject to the inquiry whether they may not be had on demand priately. The difficulties involved in the determination of the date of distribution or sale are in many instances insuperable, and in many cases unprofitable, since the only result of the inquiry would be the discovery of the date of issue of so few copies, often of one only, as not to constitute publication in the sense of distribution at all. Further, the assumption by Dr. Allen that in adopting this rule the Zoological Section of the American Association for the Advancement of Science were violating existing rules and customs is far from correct. It really formulated the "rule generally adopted by scientific bodies," as stated by Dr. Allen, "to the effect that the ostensible date, as that given on the title page of a book or pamphlet, or at the bottom of the signatures, shall be taken as the correct date, unless known to be erroneous." These dates are simply the dates of printing of the separate part or whole of a book on which they are placed, and are not the date of distribution, which cannot, of course, be printed with the book.

E. D. COPE.

GLACIERS IN THE MONTANA ROCKIES.

IN my paper published in SCIENCE of December 13, 1895, and giving an account of some explorations in the Rocky Mountains between the Great Northern Railway and the International Boundary, I mentioned the existence of several other glaciers than the one particularly described.* My attention has been since called to a paper presented by Mr. G. C. Culver, now of the State Normal School at Stevens Point, Wisconsin, to the Wisconsin Academy of Sciences, in which he describes his explorations in that region. Mr. Culver accompanied an exploring party commanded by Lieut. Ahern, U. S. A., and made many interesting observations. He did not personally visit any of the glaciers, but was in camp near one of the largest for two or more days. This is now located upon the military map of the state under the name of Culver glacier. In his paper on the subject Mr. Culver describes the glacier, but does not name it. The Culver glacier lies to the northwest of that described in my paper of December last and about fifteen or more miles distant. Mr. Culver locates upon his map several small glaciers in the general vicinity of that explored by myself. His route was such that at no point upon it could the glacier described by me be even seen. I am sure of this both from personal familiarity with the ground and from the testimony of friends who have penetrated the

*This glacier has since been referred to by Dr. Sperry and others as the Chaney glacier.

region for the purpose of hunting. I wish now to add that during the past summer Dr. L. B. Sperry, who was with me a year ago, has again visited the region and solved the problem of the glacial water of Avalanche Lake, as described in my former paper. His party discovered in the mountains at the head of Avalanche Basin, a hitherto unknown glacier which will hereafter be known as the Sperry glacier. Like the majority of the glaciers of this region it begins in narrow gorges, high up in the mountains, and spreads out into a hand-like mass terminating near the top of the cliffs above Avalanche Basin. In form it is the exact opposite of the glacier explored by myself. That seems to be unique among those yet discovered in filling a large amphitheatre and in extruding thence by a long narrow tongue much farther down the mountain side than do any of the others.

L. W. Chaney, Jr.

Carleton College,
Northfield, Minnesota.

International Cooperation in Aëronautics.

To the Editor of Science: The excellent article published in your issue of October 9th on an International Association for the Advancement of Science deserves the attention of every friend of scientific progress. If your suggestions are adopted, as they certainly will be, the rivalry between different nations will become beneficial, as the peculiar genius of each will serve to excite mutual emulation.

A good example of what cooperation can accomplish may be found in the proceedings of the International Congress of Meteorology held in Paris during September. I shall confine myself to a brief notice of what has been accomplished by the Committee for Scientific Aëronautics, of which Mr. Lawrence A. Rotch and I are members. It is well known that in 1892 MM. Hersuite and Besançon carried out experiments with balloons and measured the temperature of the air at altitudes exceeding 10,000 meters. By gradually enlarging the diameter of these balloons altitudes exceeding 60,000 m. have been reached and temperatures below 50° C. have been recorded. These experiments published in the *Comptes Rendus* and in *L'Aërophile*, attracted the attention of the Aëronautical Society, of Berlin, which has sent up to great altitudes a number of free balloons carrying self-registering instruments. This work was assisted by a large subscription from the Emperor of Germany.

It has now been proposed to establish a series of simultaneous ascents from Paris, Berlin and Strasburg (where an Alsatian Aëronautical Society has recently been formed), and ultimately from St. Petersburg. This work is under the charges of the Committee on Aëronautics appointed at the Meteorological Conference. A free balloon will be sent up from Paris by Wm. Hersuite and Besançon, on November 14th, at 2 p. m., and it has been requested that balloons be sent up from the German stations at the same time. This night has been selected in view of the meteoric showers, as ascensions may be made to advantage by aëronauts to observe the meteors above the clouds, and they could at the same time secure records with barometers and thermometers. I may be permitted to say that I have myself set the example of making an ascent on that night, which I did as far back as 1867. The results of this ascent by night were published in *Aërial Travels*, edited by T. Glaisher.

If this short note should induce any American observer to make an ascent or to send up free balloons at the dates fixed on in France and Germany, he will do a great service by publishing the results in Science, so that they may be known abroad.

W. de Fonvielle.

Paris, October 30, 1896.

Scientific Literature.

The Life and Letters of George John Romanes: Written and edited by his wife. 8vo. Pp. IX., 360. Longmans, Green & Co., London, New York and Bombay.

This charming memorial of Romanes should be widely read. Romanes was not only an investigator of ability, a writer of great gift, but he was also a man endowed with a rare combination of personal qualities. The portrayal of his character is an interesting revelation even to those familiar with his writings. The biography is more than well done, for it bears on every page the signs of loving discrimination, and, though the editor retires entirely behind

her work, yet that work in itself reveals a personality which must have influenced Romanes' career profoundly, contributing to his development and to that joyous note to which his life seemed attuned until the last years of desperate illness.

Romanes was born at Kingston, Canada, May 20, 1848, and died May 23, 1894. His life, however, belongs wholly to England. His boyhood afforded little opportunity for development, and brought no revelation of his ability, nor was it until he entered Cambridge University that his strength began to show, being called forth largely by the influence of the distinguished physiologist, Michael Foster. While at Cambridge he read for the first time Darwin's works, which became the lastingly dominant influence of his life. Darwin's theory satisfied at once his appreciation of scientific exactitude and his love of broad philosophic problems. The great naturalist formed a close and touching friendship with his young and eager disciple. Their correspondence fills much of the first third of the volume. It continued until Darwin's death. It is most interesting, not only to naturalists, but also from its revelations of character.

Romanes' life was that of a student and with no very striking external events. His biography, therefore, has no element of adventure, but shows us the rôle of one who was active in shaping biological opinion on some of the most momentous questions of the time, pangenesis, the inheritance of acquired characters, the origin of instinct and the evolution of mind. His publications show the man's intellectual magnitude; his biography shows the enthusiasm, the whole-hearted devotion to truth, the generous love of fair play and hatred of personal controversy, which marked him as a character apart.

When Darwin's Life and Letters were published, the fact that he gradually lost his interest in poetry and art made so profound an impression that many began asking whether science made life so barren. It is therefore remarkable that Darwin's foremost disciple in England should have been distinguished by an almost passionate love of both music and poetry, and have also had a deep religious instinct. The story of his religious convictions is most significant. In 1873 he won the Burney prize essay on 'Christian Prayer and General Laws,' and only three years later issued his agnostic book, 'A Candid Examination of Theism.' "It is an able piece of work," says the editor, "and is marked throughout by a lofty spirit, a profound sadness and a belief (which years after he criticised sharply) in the exclusive light of the scientific method in the Court of Reason." His last work, published posthumously, was 'Thoughts on Religion,' the outward expression of the inner change by which he returned to Christian faith.

Romanes had also the poetic faculty, and some of his sonnets are striking. His personal ties were numerous, varied and close, as was natural to a man of so many endowments and of a sympathetic temperament. It is singular to note that he cared comparatively little about painting or the beauties of nature.

The material for the biography is rich in scientific interest and still richer in personal human interest, for Romanes himself was rich in gifts. We are grateful to his wife for so presenting the material that many who did not know him can learn to appreciate him and gain encouragement from his example of industry, sincerity and fortitude. C. S. MINOT.

On Certain Problems of Vertebrate Development. JOHN BEARD. Jena, Gustav Fischer. 1896. 8vo.

This pamphlet of 77 pages is published to secure attention to the author's theory of animal development. He has claimed, in previous publications, that each individual begins with one generation sexually produced, which produces another genration asexually, the second generation becoming the adult animal. So far as has yet appeared, this theory rests upon the author's observation that the epidermis contributes, in early embryonic stages, to the production of nerve cells. The transformations of these cells *he has not followed*; hence, he concludes, they have disappeared or are transient; hence the whole embryo is a transient structure and, therefore, represents a separate generation. It may be questioned whether a failure to study the fate of certain cells in an embryo is a suf-

ficient basis to construct a revolutionary theory upon.

In the present pamphlet the author discourses at length upon the well-known fact that in all vertebrates there is an embryonic period at the close of which the anlages of all are present, but not yet differentiated. This stage he calls the 'critical stage,' and he has tabulated the condition of the principal structures in various vertebrates at this stage. This table is a welcome addition to our embryological conveniences.

We have been unable to see that the elementary facts, which the author has collated, are anything more than what is commonly taught beginners in embryology, nor to recognize that they afford any arguments to support the author's theory of 'antithetic generation.' The established conception that the embryo is designed to provide undifferentiated tissue for development rests undisturbed, and offers a sufficient interpretation of embryos, without the interpolation of an antithetic hypothesis.

The note of personal exultation predominates in the pamphlet, and the author closes with the following words: "All the things mentioned above, and many more, are in agreement with the view of an antithetic alteration as underlying Metazoon development and—where are the *facts* that are opposed to it?" And echo answers—'where?' C. S. M.

A Handbook of Rocks for use without the Microscope. By James Furman Kemp. With a Glossary of the names of rocks and of other lithological terms.

This little book is arranged to meet the special needs of those 'engaged in ordinary field work or in mining or engineering enterprise,' and to present for their use the main facts of petrography in a convenient, compact and intelligible form. As the men who nowadays are engaged in such work or in directing such enterprise usually obtain their preliminary knowledge at one or other of our technical schools or colleges, the book will prove of especial value to students in such institutions to be used for private reading in connection with their lectures and demonstrations. A thorough knowledge of the science of petrography, as of the allied sciences, botany or zoology, can, only be obtained by the continuous use of the microscope; the book, therefore, does not pretend to be a complete petrographical teatise, but for the purpose of the class of students for whom it is intended it contains an admirable presentation of the subject.

The various rock-forming minerals are first described and the principles of petrographical classification explained. Five chapers are then devoted to the Igneous Rocks. The student's attention is especially directed to the chemical composition of the several rocks, a series of analyses of each group being presented and commented upon. The mineralogical composition and relationship of the rocks of this class are excellently summed up in a tabular form on page 18, and are also represented graphically by means of diagrams which, however, would be rendered clearer if drawn to a larger scale.

The aqueous or sedimentary rocks are then taken up and finally the processes of metamorphism are explained and the principal representatives of the group of the metamorphic rocks are described.

It seems, however, unfortunate that the author has seen proper to include among the metamorphic rocks all the products of ordinary atmospheric weathering and decay, so that common clay, if a residual product, is classed as a metamorphic rock. This stretching of Lyell's original definition of metamorphism to include all alteration products of whatever kind is hardly advisable. The products of heat and pressure and those of ordinary superficial weathering are too diverse to be properly included in the same class, even if one were not willing to go so far as Prof. Dana and eliminate from the class of metamorphic rocks all those rocks which are products of alterations which take place at ordinary temperatures.

Appended to the book is an excellent glossary of rock names, which will prove of great value to beginners as well as to more advanced students, for, as Prof. Kemp observes: "One only needs to compile a glossary to appreciate what numbers of unnecessary and ill-advised names for rocks burden this unfortunate branch of science and to convince one that the philological petrographer comes near to being the

enemy of his kind." This glossary is to a certain extent based upon Loewinson-Lessing's Petrographisches Lexikon and the index of Zirkel's Lehrbuch der Petrographie, but contains many additional names of American origin. As an index of rock names it is very full and correct, although a few unimportant slips were observed. The name Anarthosite, for instance, was proposed by Hunt as far back as 1863 (See Geology of Canada, p. 22), six years before the publication of the paper in the *American Journal of Science*, to which reference is made. Perthite again was not named by Hunt, but by Dr. Thompson, of Perth, while composite dykes are not in all cases formed by two intrusions of different age occupying the same fissure, but in some cases result from magmatic differentiation in a single injection.

The book is clearly written, and the fact that it deals chiefly with American rocks and American localities gives it for American students a distinct advantage over many of the text-books which are published abroad.

FRANK D. ADAMS.
McGILL UNIVERSITY.

Prantl's Lehrbuch der Botanik, herausgegeben and neu arbeitet von DR. FERDINAND PAX, ord. Professor der Botanik und Direktor des botanischen Gartens in Breslau. Mit 397 figuren in Holzschnitt. Zehnte, verbesserte und vermehrte Auflage. 8vo., pp. x+406. Leipzig, Wilhelm Engelmann. 1896. Brosch. M. 4; gebund. M 5. 30.

A text-book of botany which has passed into its tenth edition has demonstrated its fitness to meet existing conditions in its native country. Whether those conditions are good or bad is quite another question. They certainly seem to demand in Germany a book largely devoted to an account of the various groups of plants. Indeed courses upon *Systematik* are much commoner in German universities and *Hochschulen* than in this country, given over as its elementary instruction has been to 'analysis.' It would almost appear that classification there takes the place of 'analysis' here, with little advantage, if any, in favor of the German student.

The tenth edition, the reviser tells us, has been augmented both in text and illustrations, and many of the older figures replaced by better ones. This appears chiefly in the systematic part, for which the treasurers of the *Pflanzenfamilien* have been drawn upon; but no striking novelties appear in the other parts, where the good old 'stand-bys' are much in evidence still.

The 'tief greifende Veränderungen in der Anordnung des Stoffes,' which Dr. Pax did not think it wise to make, because the present arrangement had been approved by use, seem to us the very changes which were most called for in order to make the tenth edition as valuable to this generation as the first was twenty-two years ago. For according to modern ideas a text-book which devotes 100 pages to morphology, 47 to physiology and 237 to classification, is badly balanced; it is overdoing system at the expense of life. This is all the more striking when two-thirds of the classification is of the 'dry bones' order. Of the 237 pages of 'systematische Uebersicht des Pflanzenreiches,' 164 are devoted to the phanerogams, and in them one finds the same dreary iteration of the details of flower structure that has been our portion these many years. In the 73 pages on cryptogams comparative special morphology is given chief attention, but the parts shift as soon as the phanerogams are reached. Though Dr. Pax naturally wished to keep as close to Prantl's plan as possible, who would have found fault had he shown the courage to maintain the same plan for the phanerogams as for the cryptogams? Possibly the publisher; hardly the readers.

Part II., on physiology, is much too short for a satisfactory account of plant functions, and it might have been further revised to advantage in many particulars which we cannot specify. The account of molecular structure (if it is to be given at all) and the section on water movement are two notable examples. Sex terms and the sexual and non-sexual phases are properly explained in the very brief chapter on reproduction, but when the unsuspecting reader reaches the angiosperms he will be bewildered by the application of the same terms to the flowers and even to the sporophyte!

In anatomy the Gaul-like division of all tis-

sues into three systems is maintained against the much more satisfactory stelar classification of Van Tieghem. In morphology the root, stem, leaf and trichome are still recognized as equivalent members, in spite of the clearer presentation possible when root and shoot are regarded as primary members.

On the whole we must conclude that Prantl's book needed a thorough rewriting to modernize it and to make it a fit presentation of the botanical science of the close of the century. It has, of course, an immense amount of material that is good enough to commend it to many teachers who prefer to 'inquire after the old paths and walk therein.' But to this extent it contributes to stagnation instead of to progress.

Charles R. Barnes.
University of Wisconsin.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, NOVEMBER.

Diffusion of Sulphides through Steel: By E. D. Campbell. These experiments lead to some very interesting results. The method used was to drill holes in the steel bars, fill the holes with sulphide and, after filling the opening with a steel plug, heat the bars in a furnace. It was found that neither ferrous oxide nor a suboxide would diffuse through the bars; but that oxysulphides would diffuse throughout the bar and the sulphur become oxidized at the surface. Cuprous sulphide when mixed with iron-oxysulphide was found to diffuse in an unchanged state. Evidently the substances pass through the pores of the steel in a liquid and not a gaseous form, and are influenced by gravity as they accumulate at the lowest part of the bars.

Effect of Heat Treatment and Carbon upon the Solubility of Phosphorus in Steel: By E. D. Campbell and S. C. Babcock. The soluble and insoluble phosphorus was determined by treating the iron with mercuric chloride solution, when it was found that part of the phosphorus was soluble in this reagent and part not. If the amount of carbon is small the effect of heat treatment upon the solubility of phosphorus is slight; but if the amount of carbon is increased, the solubility of the phosphorus is diminished. It is probable that at high temperatures a difficultly soluble compound of iron with carbon and phosphorus is formed, which by slow cooling is converted into an easily soluble one.

Malonic Nitrile and some of its derivatives: By B. C. Hesse. The object of this investigation was to ascertain, if possible, whether in the salts of malonic nitrile, the metal is bound to nitrogen or carbon. The bromine and silver salts were prepared and studied. When the silver salts are treated with alkyl iodides, dialkyl malonic nitriles and alkyl isocyanides are formed. These facts can best be explained on the assumption that the metal is in combination with nitrogen. The action of chlorformic esters and of alkyl iodides on an alcoholic solution of malonic nitrile and sodium alcoholate was also studied. It is probable that a sodium malonic nitrile is formed, which is then acted on by the alkyl iodides. The final product of the reaction is a monimido ether, whose formation can be explained in several ways.

On the 'Beckmann Rearrangement:' By J. Stieglitz. Acid bromamides when treated with a methyl alcohol solution of sodium methylate undergo a rearrangement and give urethanes and other derivatives of the isocyanates. This rearrangement is only effected by alkaline solutions. He considers it possible that this is due to the loss of hydrobromic acid and the formation of a body $(RCO)N<$, which would cause the separation of the alkyl R from the carbon atom holding the nitrogen.

$$\begin{array}{ccccc} R-C=O & & -C=O & & C=O \\ | & \rightarrow & | & \rightarrow & \| \\ >N & & -NR & & NR. \end{array}$$

Other facts point to the same conclusion and investigations are being carried out on other classes of compounds to see whether any similar rearrangements take place.

Menthene Nitrosochloride and some of its derivatives: By W. O. Richtmann and Edward Kremers. The statements as to the melting-point of this compound are so conflicting that this investigation was undertaken to settle, if possible, this question. It was found that at least two, and possibly three, nitrosochlorides exist. A ketone was also obtained by the action of hydrochloric acid on nitrosomenthane

and some derivatives obtained from it. A number of substances were obtained whose exact natures have not yet been determined.

Tetrametaphosphimic Acid: By H. N. STOKES. In this article, which is a continuation of one recently published on the phosphimic acids, the author discusses the acid, its decompositions, and the salts formed by it. He also offers some suggestions as to its structure, but calls attention to the fact that experimental data for such a discussion is almost wholly wanting.

A short obituary notice of August Kekulé, who died July 13, 1896, is also contained in this number.

J. ELLIOTT GILPIN.

SOCIETIES AND ACADEMIES.

THE AMERICAN CHEMICAL SOCIETY.

THE regular meeting of the American Chemical Society was held at the College of the City of New York on Friday evening, November 6th, Prof. William McMurtrie in the chair, and fifty-one members present.

The announcement was made that an invitation from Drs. Morton and Leeds to hold the next meeting (December 11th) at the Stevens Institute of Technology, Hoboken, had been received, duly acted upon and accepted by the Executive Committee. Dr. Morton will read a paper on 'Some Illustrations of the Phenomena of Fluorescence,' and Dr. Leeds will give an 'Exhibition of Appliances for the Quantitative Estimation of Micro-Organisms.'

Dr. Squibb reviewed in detail the method of Messrs. Robineau and Rollin for the 'Volumettric Determination of Aceton.' (Moniteur Scientifique, 1893.) This method consists in mixing acetone with a solution of potassium iodide and sodium hydroxide, and then transforming it into iodoform with a titrated solution of a hypochlorite. The end reaction is indicated by the appearance of a blue color when a drop of the liquid is touched with a drop of bicarbonated starch solution. From the volume of hypochlorite used the quantity of acetone is deduced. Dr. Squibb has introduced various modifications which shorten the work so as to render the process available in commercial work, the details of which require a perusal of the paper in full for their due appreciation.

Dr. Doremus gave an interesting sketch of the scientific meetings held in London and Paris last summer, and of the various English and Continental laboratories visited, not the least efficient of which were several connected with large manufacturing establishments. The expensive platinum apparatus used by Moissan in the isolation of fluorine, Dewars's apparatus for liquefaction of oxygen, and photographs of the spectrum of Argon, were among many extremely interesting landmarks in the progress of chemical science which were seen and described.

Mr. J. C. Boot exhibited and described a specific gravity bottle, designed to prevent the rapid alteration of the temperature of the liquid and consequent difficulty in making accurate weighings, when the temperature of the laboratory happens to be much above the standard temperature at which the liquid must be weighed. The essential point is the inclosure of an inner by an outer bottle, the space between being quite thoroughly exhausted. The non-conductivity of the vacuum permits of maintaining the temperature of the inner bottle stationary for as much as five minutes with a room difference of twenty-five or thirty degrees.

A paper by Mr. Heath, on the colorimetric determination of copper, described methods of preparing color standards, whereby a year's permanence is assured, and other modifications conducive of accuracy and rapidity. Mr. Heath insists on the absence of nitric acid in the standards of color comparison, as well as an excess of ammonia of uniform strength, and the standards should then be preserved in absolutely tight, glass-stoppered bottles, and not exposed to heat or direct sunlight.

He objects to the method involving the use of metallic aluminum, because of the danger of incomplete precipitation, or retention of copper by silica, and the additional time required to avoid or correct errors resulting in these ways. He advocates a double precipitation, by ammonia, of the iron and alumina, redissolving in sulphuric acid for the second precipitation. His standards enable him to read to 0.03 per cent., and check assays made by electrolytic method indicate a very small range of error.

DURAND WOODMAN,
Secretary.

THE TORREY BOTANICAL CLUB.

At the meeting of October 28th two new members were elected. The reference in the last minutes to the occurrence of the Russian Thistle on Captain's Island was corrected, the plant proving to be *Salsola Kali.*

The paper by Mr. B. D. Gilbert, entitled 'A New Gymnogramme from Venezuela, with Remarks on other Venezuelan Ferns,' was presented by Prof. L. M. Underwood, the author not being present. It consisted of an exhibit of the ferns collected upon the lower Orinoco River last spring, by Messrs. Rusby and Squires. The more interesting species, besides the new one, were *Adiantum olivaceum* Baker, *Alsophila blechnoides* Hooker, *Hemitelia grandifolia* Spreng., *Hemitelia Guianenses Parkeri* Hooker, *Aspidium meniscioides* Willd. and *Antrophyum subsessile* Kze.

A discussion followed on the heterogeneous character of the elements at present included in the genus Gymnogramme, and it was agreed that the new species was naturally a Polypodium and that its necessary reference to Gymnogramme was due to artificial genus-limits.

Dr. H. H. Rusby described a new genus from Bolvia, in the family *Icacinaceæ*, illustrating by specimens and blackboard drawings. Its structural relations to the other groups of the family and to the associated genera were carefully pointed out. The communication was discussed by Dr. Britton.

A communication from Miss S. B. D. Lewis on the species of Nymphea found in Raquette Lake was beautifully illustrated by colored drawings. The form of *Pontederia cordate*, with cream flowers, was also reported by Miss Lewis. An animated discussion of the communication was participated in by Dr. Britton, Prof. Lloyd, Mr. Rydberg, Mrs. Britton and the Secretary.

Dr. Allen remarked on his collections and observations in the far North, and exhibited a number of interesting specimens.

H. H. Rusby,
Recording Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

At the meeting of November 2, 1896, Mr. Colton Russell spoke of 'what an entomologist can find of interest about St. Louis,' illustrating his remarks by numerous pinned specimens of insects, giving particular attention to the butterflies, and speaking at some length of the phenomena of periodicity, migration, polymorphism, etc., as illustrated by these insects, his paper embodying the result of a large amount of field work performed during the past ten years. Resolutions opposing the passage of the anti-vivisection bill now before the United States Senate were adopted. Three persons were elected to active membership.

Wm. Trelease,
Recording Secretary.

TEXAS ACADEMY OF SCIENCE.

At a meeting of the Texas Academy of Science, held at the University of Texas on October 2d, Dr. George Bruce Halsted gave an account of his recent travels in Russia. At a regular meeting of the same association, held on November 6th, Prof. T. U. Taylor, C. E., gave an abstract of a somewhat extended paper on Roads in the Black Waxy Lands of Texas, in which he discussed the best methods of construction, the cost of labor, results already attained, etc. Dr. Frederic W. Simonds also presented an important paper at this meeting, a tribute to his friend and teacher, Prof. Ch. Fred. Hartt, M. A., the first Professor of Geology at Cornell University, who died in 1878, when Chief of the Geological Commission of Brazil. This sketch will be published in full in one of the leading scientific journals.

NEW BOOKS.

The Cell in Development and Inheritance. Edmund B. Wilson. London and New York, The Macmillan Co. 1896. Pp. xvi + 371. $3.00.

The Survival of the Unlike. L. H. Bailey. New York and London, The Macmillan Co. 1896. Pp. 515. $2.50.

The American Commonwealth. (Abridged edition.) James Bryce. New York and London, The Macmillan Co. 1896. Pp. xiii + 547. $1.75.

The Story of the Mine. Charles Howard Shinn. New York, D. Appleton & Co. 1896. Pp. vii + 272. $1.50.